National Park Service
U.S. Department of the Interior

Amistad National Recreation Area
Texas

AMISTAD
NATIONAL RECREATION AREA

Personal Watercraft Use
Environmental Assessment

Please Note:
Table of Contents contains links to navigate document

Printed on recycled paper

National Park Service
U.S. Department of the Interior

Amistad National Recreation Area
Texas

AMISTAD
NATIONAL RECREATION AREA

Personal Watercraft Use
Environmental Assessment

March 2003

SUMMARY

Amistad National Recreation Area lies along the United States-Mexico border near Del Rio, Texas. The unit consists of 57,292 acres and is a man-made reservoir resulting from the construction of a 6-mile long dam on the Rio Grande. The reservoir is 1,117 feet above sea level at the normal conservation level, and the park boundary continues 83 miles northwest up the Rio Grande, 25 miles north up the Devils River, and 14 miles north up the Pecos River. The park boundary varies but is generally at the elevation mark of 1,144.3 feet above mean sea level, and the lake level fluctuates in relation to this. Amistad is home to a rich archeological record and world-class rock art. Within or immediately adjacent to park boundaries are four archeological districts and one site listed on the National Register of Historical Places.

Amistad National Recreation Area supports a wide variety of boating activities throughout the year, including PWC use, powerboating, waterskiing, houseboating, boat fishing, sightseeing by boat, sailboating, sailboarding, canoeing, and kayaking.

The purpose of and the need for taking action is to evaluate a range of alternatives and strategies for managing PWC use at Amistad in order to ensure the protection of park resources and values while offering recreational opportunities as provided for in the national recreation area's enabling legislation, purpose, mission, and goals. Upon completion of this process in accordance with the National Environmental Policy Act (NEPA), the National Park Service (NPS) may either take action to adopt special regulations to manage PWC use, or it may discontinue PWC use at this park unit.

BACKGROUND

More than one million personal watercraft are estimated to be in operation today in the United States. Sometimes referred to as "Jet Skis" or "Wet Bikes," these vessels use an inboard, internal combustion engine powering a water jet pump as its primary source of propulsion. They are used for enjoyment, particularly for touring and maneuvers such as wave jumping, and they are capable of speeds in the 60 mph range. PWC recreation was the fastest growing segment of the boating industry through the mid 1990s, representing over a third of total sales. While PWC use remains a relatively new recreational activity, it has occurred in 32 of the 87 national park system units that allow motorized boating.

After studies in Everglades National Park showed that PWC use resulted in damage to vegetation, adversely impacted shorebirds, and disturbed the life cycles of other wildlife, the National Park Service prohibited PWC use by a special regulation at the park in 1994. In recognition of its duties under its Organic Act and NPS *Management Policies,* as well as increased awareness and public controversy about PWC use, the National Park Service subsequently reevaluated its methods of PWC regulation. Historically, the National Park Service had grouped personal watercraft with all vessels; thus, PWC use was allowed when the superintendent's compendium allowed the use of other vessels. Later the Park Service closed seven units to PWC use through the implementation of horsepower restrictions, general management plan revisions, and park-specific regulations such as those promulgated by Everglades National Park.

In May 1998 the Bluewater Network filed a petition urging the National Park Service to initiate a rulemaking process to prohibit PWC use throughout the national park system. In response to the petition, the Park Service issued an interim management policy requiring superintendents of parks where PWC use can occur but had not yet occurred to close the unit to such use until the rule was finalized. The Park Service envisioned the servicewide regulation as an opportunity to evaluate

impacts from PWC use before authorizing the use. On March 21, 2000, the National Park Service issued a regulation prohibiting PWC use in most units and required 21 units to determine the appropriateness of continued PWC use.

In response to the PWC final regulation, Bluewater Network sued the National Park Service, challenging the Park Service's decision to allow continued PWC use in 21 units while prohibiting PWC use in other units. In response to the suit, the National Park Service and the environmental group negotiated a settlement. Each park desiring to continue long-term PWC use must promulgate a park-specific special regulation in 2002. In addition, the settlement stipulates that the National Park Service must base its decision to issue a park-specific special regulation to continue PWC use through an environmental analysis conducted in accordance with the National Environmental Policy Act. The NEPA analysis at a minimum, according to the settlement, must evaluate PWC impacts on water quality, air quality, soundscapes, wildlife, wildlife habitat, shoreline vegetation, visitor conflicts, and visitor safety.

The proposed September 16, 2002, prohibition of personal watercraft was averted with the execution of a stipulated modification of the settlement agreement, approved by the court on September 9, 2002. The agreement extended unrestricted PWC use in Amistad National Recreation Area until November 6, 2002. If as a result of the environmental assessment an alternative is selected that would allow PWC use to continue, then a special regulation to authorize that use will be drafted.

ALTERNATIVES CONSIDERED

This environmental assessment evaluates three alternatives concerning the use of personal watercraft at Amistad National Recreation Area.

- Alternative A would continue PWC use under a special NPS regulation in accordance with NPS *Management Policies 2001,* park practices, and state regulations.
- Alternative B would continue PWC use under a special regulation, but specific limits and use areas would be defined.
- The no-action alternative would eliminate PWC use entirely within this national park system unit.

Based on the environmental analysis prepared for PWC use at Amistad National Recreation Area, alternative A is the preferred alternative and is also considered the environmentally preferred alternative because it would best fulfill park responsibilities as trustee of this sensitive habitat; ensure safe, healthful, productive, and aesthetically and culturally pleasing surroundings; and attain a wider range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.

ENVIRONMENTAL CONSEQUENCES

Impacts of the three PWC management alternatives were assessed in accordance with *Director's Order #12: Conservation Planning, Environmental Impact Analysis and Decision-making.* The *Director's Order #12 Handbook* requires that impacts to park resources be analyzed in terms of their context, duration, and intensity. It is crucial for the public and decision-makers to understand the implications of those impacts in the short and long term, cumulatively, and within context, based on an understanding and interpretation by resource professionals and specialists.

To determine impacts, methodologies were identified to measure how park resources would change with the implementation of the PWC management alternatives. Thresholds were established for each impact topic to help understand the severity and magnitude of changes in resource conditions.

Each PWC management alternative was compared to a baseline to determine the context, duration, and intensity of resource impacts. The baseline, for purposes of impact analysis, is the continuation of PWC use and current management projected over the next 10 years (alternative A). Table A summarizes the results of the impact analysis for the impact topics that were assessed. The analysis was conducted in 2002 and considered a 10-year period (2002–2012).

TABLE A: SUMMARY OF THE IMPACT ANALYSIS

Impact Topic	Alternative A: Continue PWC Use under a Special NPS Regulation	Alternative B: Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative — No PWC Use
Water Quality	PWC use impacts: Negligible adverse impacts over the short and long term. All pollutant loads well below benchmarks and criteria. Cumulative impacts: Negligible adverse impacts, with emissions substantially reduced by 2012 as a result of technological improvements.	PWC use impacts: Negligible adverse impacts in the reservoir and Rio Grande (area 1). Beneficial impacts in the Devils River and San Pedro Canyon (area 2) as a result of no PWC use. Cumulative impacts: Negligible adverse impacts, with impacts reduced substantially by 2012.	PWC use impacts: Beneficial impacts as a result of banning PWC use. Cumulative impacts: Negligible adverse impacts, with no contribution from PWC use.
Air Quality			
• Impacts to Human Health from Airborne Pollutants Related to PWC Use	PWC use impacts: Short- and long-term, negligible, adverse impacts for all pollutants. Cumulative impacts: Short- and long-term, negligible adverse impacts from PM_{10}, HC, VOC, and $NO_{x;}$ moderate adverse impacts from CO. Slight increase in NO_x emissions by 2012, with a negligible adverse effect. No alteration to existing air quality conditions; future reductions anticipated in PM_{10}, HC, and VOC emissions.	PWC use impacts: Short- and long-term, negligible, adverse impacts for all pollutants. Cumulative impacts: Short- and long-term, negligible, adverse impacts from PM_{10}, HC, VOC, and $NO_{x;}$ moderate adverse impacts from CO. Slight increase in NO_x emissions by 2012, with a negligible adverse effect. Future reductions in PM_{10}, HC, and VOC emissions.	PWC use impacts: Beneficial impacts because of banning PWC use. Cumulative impacts: Short- and long-term, moderate adverse impacts for CO; negligible adverse impacts for other pollutants. Future emission rates of most pollutants would gradually decline.
• Impacts to Air Quality Values from Pollutants Related to PWC Use	PWC use impacts: Negligible adverse effects for ozone exposure for 2002 and 2012; no adverse effects to plants. Negligible impacts on visibility from PWC use. Cumulative impacts: Negligible adverse impacts.	PWC use impacts: Negligible adverse impacts in 2002 and 2012. Cumulative impacts: Negligible adverse impacts in 2002 and 2012.	PWC use impacts: Beneficial impacts as a result of eliminating PWC use. Cumulative impacts: Negligible ozone impacts from airborne pollutants related to all other boating activities. Negligible impacts on visibility.
Soundscapes	PWC use impacts: Short-term, minor, adverse impacts at most locations during the use season; minor to moderate adverse impacts along the reservoir shoreline and near shoreline camping locations. Cumulative impacts: Minor to moderate adverse impacts, with the highest sound impacts near boat launches, beaches, and marinas.	PWC use impacts: Short-term, minor adverse impacts at most locations during the use season; long-term, minor to moderate, adverse impacts along the reservoir shoreline. Beneficial impacts from eliminating PWC use in specific segments. Cumulative impacts: Minor adverse impacts, with the highest sound increases near Diablo East and Spur 454, and the highest decreases along the Devils River and in San Pedro Canyon.	PWC use impacts: Beneficial impacts as a result of eliminating PWC use. Cumulative impacts: Minor adverse impacts, particularly near the Diablo East boat launch.
Wildlife and Wildlife Habitat	PWC use impacts: Negligible adverse impacts at most locations. Limited effects from PWC use or proximity to wildlife because of no-wake restrictions within 50 feet of the shore.	PWC use impacts: Negligible adverse impacts at most locations. Limited effects from PWC use or proximity to wildlife because of no-wake restrictions with 50 feet of the shore. Cumulative impacts: Negligible to	PWC use impacts: No impacts from PWC use. Cumulative impacts: Negligible or no adverse impacts to fish; negligible to minor impacts to waterfowl and other wildlife. No

Impact Topic	Alternative A: Continue PWC Use under a Special NPS Regulation	Alternative B: Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative — No PWC Use
	Cumulative impacts: Negligible to minor adverse effects. All impacts would be temporary and short term.	minor adverse effects. All impacts would be temporary and short term.	perceptible changes in wildlife populations or their habitat community structure.
Threatened or Endangered Species or Species of Special Concern	PWC use impacts: No effect or not likely to adversely affect any federal or state listed species. Cumulative impacts: Not likely to adversely affect these species.	PWC use impacts: No effect or not likely to adversely affect any federal or state listed species. Reduced adverse impacts from restricting PWC use in upstream areas and increased minor disturbance to species using open water. Cumulative impacts: Not likely to adversely affect these species.	PWC use impacts: No effect on federal or state listed species. Cumulative impacts: Not likely to adversely affect federal or state listed animals and plants.
Shoreline Vegetation	PWC use impacts: Negligible adverse impacts. Cumulative impacts: Negligible adverse impacts.	PWC use impacts: Negligible adverse impacts. Beneficial impacts to shoreline vegetation in closed areas. Cumulative impacts: Negligible adverse impacts.	PWC use impacts: Beneficial impacts from eliminating PWC use. Cumulative impacts: Negligible adverse impacts.
Visitor Experience	PWC use impacts: Negligible adverse impacts for most visitors. Long-term, negligible, adverse impacts on shoreline campers, but long-term, minor adverse impacts on swimmers and other visitors using official park campgrounds. Cumulative impacts: Long-term, negligible to minor, adverse impacts.	PWC use impacts: Negligible adverse impacts for most visitors. Beneficial impacts on swimmers and visitors desiring natural quiet with PWC use restrictions. Cumulative impacts: Long-term, negligible, adverse impacts.	PWC use impacts: Beneficial impacts for most visitors. Long-term, moderate, adverse impacts for PWC users. Cumulative impacts: Beneficial impacts for most visitors. Negligible adverse impacts at other Texas waterbodies as a result of displaced PWC users.
Visitor Conflicts and Safety	PWC use impacts: Short- and long-term, minor to moderate, adverse impacts in high-use areas. Negligible conflicts at other locations because use is lower. Cumulative impacts: Minor to moderate adverse impacts for all user groups, particularly near high-use areas. Negligible cumulative impacts in other segments.	PWC use impacts: Minor, adverse impacts. Beneficial impacts to swimmers at San Pedro; negligible adverse impacts for other boaters. Negligible conflicts at other locations. Beneficial impacts from eliminating conflicts in the Pecos River. Cumulative impacts: Minor to moderate adverse impacts for all user groups, particularly at Diablo East and San Pedro. Negligible impacts in other segments.	PWC use impacts: Beneficial impacts. Cumulative impacts: Negligible adverse impacts from other sources.
Cultural Resources (Archeological Sites, Submerged Cultural Resources)	PWC use impacts: Minor adverse impacts from possible illegal collection and vandalism. Cumulative impacts: Minor to moderate adverse impacts due to the number of visitors and the potential for illegal collection or damage.	PWC use impacts: Minor adverse impacts from possible illegal collection and vandalism. Beneficial impacts in areas where PWC use banned. Cumulative impacts: Minor to moderate adverse impacts due to the number of visitors and the potential for illegal collection or damage.	PWC use impacts: Minor beneficial impacts from eliminating PWC use. Cumulative impacts: Minor to moderate adverse impacts, depending on the accessibility of resources and the potential for illegal collection or damage.
Socioeconomic Effects	No change in PWC use anticipated, so no additional impact on the local or regional economy is expected.	No measurable impact on the local or regional economy expected as a result of PWC management restrictions.	Visitors who use personal watercraft exclusively might no longer visit the park. No measurable impact on the local or regional economy is expected.
National Recreation Area Management and Operations			
• Conflict with State and Local Regulations	No conflicts with state regulations. Negligible impacts (including cumulative).	Same as alternative A.	Same as alternative A.
• Impact to Park Operations from Increased Enforcement Needs	PWC use impacts: Negligible impacts because increased enforcement staff already anticipated; no additional enforcement requirements. Cumulative impacts: Minor.	PWC use impacts: Short-term, minor adverse impacts due to additional enforcement requirements until visitors became aware of the restrictions. Cumulative impacts: Minor.	PWC use impacts: Short-term, minor adverse impacts until visitors adjusted to the PWC use ban. Long-term beneficial impacts because of additional staff time for other activities. Cumulative impacts: Minor.

No park resources or values would be impaired under any alternative.

CONTENTS

Maps

Figures

Tables

PURPOSE OF AND NEED FOR ACTION

Amistad National Recreation Area lies along the United States-Mexico border near Del Rio, Texas. The unit consists of 57,292 acres and is a man-made reservoir resulting from the construction of a 6-mile long dam on the Rio Grande. The reservoir is 1,117 feet above sea level at the normal conservation level, and the park boundary continues 83 miles northwest up the Rio Grande, 25 miles north up the Devils River, and 14 miles north up the Pecos River. The park boundary varies but generally is at elevation mark of 1,144.3 feet above mean sea level, and the lake level fluctuates in relation to this elevation. Amistad is home to a rich archeological record and world-class rock art. Within or immediately adjacent to park boundaries are four archeological districts and one site listed on the National Register of Historical Places.

Amistad supports a wide variety of boating activities throughout the year, including PWC use, power-boating, waterskiing, boat fishing, sightseeing by boat, sailboating, sailboarding, canoeing, and kayaking.

More than one million personal watercraft* are estimated to be in operation today in the United States. Sometimes referred to as "Jet Skis" or "Wet Bikes," these vessels use an inboard, internal combustion engine powering a water jet pump as the primary source of propulsion. They are used for enjoyment, particularly for touring and maneuvers such as wave jumping, and they are capable of speeds in the 60 mph range. PWC recreation was the fastest growing segment of the boating industry through the mid 1990s, representing over one-third of total sales.

The National Park Service (NPS) maintains that personal watercraft emerged and gained popularity in park units before it could initiate and complete a "full evaluation of the possible impacts and ramifications." While PWC use remains a relatively new recreational activity, it has occurred in 32 of the 87 park units that allow motorized boating.

The National Park Service first began to study PWC use in Everglades National Park. The studies showed that PWC use over emergent vegetation, shallow grass flats, and mud flats commonly used by feeding shorebirds damaged the vegetation, adversely impacted the shorebirds, and disturbed the life cycles of other wildlife. Consequently, managers at Everglades determined that PWC use remained inconsistent with the resources, values, and purposes for which the park was established. In 1994 the National Park Service prohibited PWC use by a special regulation at the park (59 FR 58781).

Other public entities have taken steps to limit and even to ban PWC use in certain waterways as national researchers study more about the effects of PWC use. At least 34 states have either implemented or have considered regulating the use and operation of personal watercraft (63 FR 49314). Similarly, various federal agencies, including the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration, have managed personal watercraft differently than other classes of motorized watercraft.

---

* Personal watercraft, as defined in 36 CFR 1.4(a) (2000), refers to a vessel, usually less than 16 feet in length, which uses an inboard, internal combustion engine powering a water jet pump as its primary source of propulsion. The vessel is intended to be operated by a person or persons sitting, standing, or kneeling on the vessel, rather than within the confines of the hull. The length is measured from end to end over the deck excluding sheer, meaning a straight line measurement of the overall length from the foremost part of the vessel to the aftermost part of the vessel, measured parallel to the centerline. Bow sprits, bumpkins, rudders, outboard motor brackets, and similar fittings or attachments, are not included in the measurement. Length is stated in feet and inches.

Specifically, the National Oceanic and Atmospheric Administration regulates PWC use in most national marine sanctuaries. The regulation resulted in a court case where the Court of Appeals for the District of Columbia declared such PWC-specific management valid. In *Personal Watercraft Industry Association v. Department of Commerce*, 48 F.3d 540 (D. C. Cir. 1995), the court ruled that an agency can discriminate and manage one type of vessel (specifically personal watercraft) differently than other vessels if the agency explains its reasons for the differentiation.

In February 1997 the Tahoe Regional Planning Agency (TRPA), the governing body charged with ensuring no derogation of Lake Tahoe's water quality, voted unanimously to ban all two-stroke, internal combustion engines, including personal watercraft, because of their effects on water quality. Lake Tahoe's ban began in 2000.

In July 1998 the Washington State Supreme Court in *Weden v. San Juan County* (135 Wash. 2d 678 [1998]) found that the county had the authority to ban the use of personal watercraft as a proper use of its police power in order to protect the public health, safety, or general welfare. Further, personal watercraft are different from other vessels, and Washington counties have the authority to treat them differently.

In recognition of its duties under its Organic Act and its *Management Policies,* as well as because of increased awareness and public controversy, the National Park Service reevaluated its methods of PWC regulation. Historically, the National Park Service had grouped personal watercraft with all vessels; thus, people could use personal watercraft when the unit's superintendent's compendium allowed the use of other vessels. Later the Park Service closed seven units to PWC use through the implementation of horsepower restrictions, general management plan revisions, and park-specific regulations such as those promulgated by Everglades National Park.

In May 1998 the Bluewater Network, a private, independent, nonprofit organization, filed a petition urging the National Park Service to initiate the rulemaking process to prohibit PWC use throughout the national park system. In response to the petition, the Park Service issued an interim management policy requiring superintendents of parks where PWC use can occur but where the use had never occurred to close the unit to such use until the rule was finalized. In addition, the National Park Service proposed a specific PWC regulation premised on the notion that personal watercraft differ from conventional watercraft in terms of design, use, safety record, controversy, visitor impacts, resource impacts, horsepower to vessel length ratio, and thrust capacity (63 FR 178 [Sept. 15, 1998]: 49312–17).

The National Park Service envisioned the servicewide regulation as an opportunity to evaluate impacts from PWC use before authorizing the use. The preamble to the servicewide regulation calls the regulation a "conservative approach to managing PWC use" considering the resource concerns, visitor conflicts, visitor enjoyment, and visitor safety. During a 60-day comment period the National Park Service received nearly 1,800 comments.

As a result of public comments and further review, the National Park Service promulgated an amended regulation that prohibited PWC use in most units and required the remaining units to determine the appropriateness of continued PWC use (36 CFR 3.24(a) 2000); 65 FR 55 [Mar. 21, 2000]: 15077–90). Specifically, the regulation allowed the National Park Service to designate PWC use areas and to continue their use by promulgating a special regulation in 11 units and by amending the superintendent's compendium in 10 units (36 CFR 3.24(b) 2000). The National Park Service based the distinction between designation methods on the unit's degree of motorized watercraft use.

In response to the PWC final regulation, Bluewater Network sued the National Park Service under the Administrative Procedures Act and the NPS Organic Act. The organization challenged the National Park Service's decision to allow continued PWC use in 21 units while prohibiting PWC use in other units. In addition, the organization also disputed the National Park Service's decision to allow 10 units to continue PWC use after 2002 by making entries in the superintendent's compendium, which would not require the opportunity for public input through a notice and comments on the rulemaking process. Further, the environmental group claimed that because PWC use causes water and air pollution, generates increased noise levels, and poses public safety threats, the National Park Service acted arbitrarily and capriciously when making the challenged decisions.

In response to the suit, the National Park Service and the environmental group negotiated a settlement. The resulting settlement agreement, signed by the judge on April 12, 2001, changed portions of the National Park Service's PWC rule. While 21 units could continue PWC use in the short term, each of those parks desiring to continue long-term PWC use must promulgate a park-specific special regulation in 2002. In addition, the settlement stipulates that the National Park Service must base its decision to issue a park-specific special regulation to continue PWC use through an environmental analysis conducted in accordance with the National Environmental Policy Act (NEPA). The NEPA analysis at a minimum, according to the settlement, must evaluate PWC impacts on water quality, air quality, soundscapes, wildlife, wildlife habitat, shoreline vegetation, visitor conflicts, and visitor safety.

In 2001 the National Park Service adopted its new management policy for personal watercraft. The policy prohibits PWC use in national park system units unless their use remains appropriate for the specific park unit (*Management Policies 2001,* sec. 8.2.3.3). The policy statement authorizes the use based on the park's enabling legislation, resources, values, other park uses, and overall management strategies.

As the settlement deadline approached and the park units were preparing to prohibit PWC use, the National Park Service, Congress, and PWC user groups sought legal methods to keep the parks open to this activity. However, no method was successful. On April 22, 2002, the following units closed for PWC use: Assateague Island National Seashore; Big Thicket National Preserve; Pictured Rocks National Lakeshore; Fire Island National Seashore; and Gateway National Recreation Area. On September 15, 2002, eight other park units were scheduled to close to PWC use, including Amistad National Recreation Area.

The proposed September 16, 2002, prohibition of personal watercraft was averted with the execution of a stipulated modification to the settlement agreement. The modified settlement agreement was approved by the court on September 9, 2002, and extended unrestricted PWC use at selected national park system units, including Amistad National Recreation Area, until November 6, 2002. Park units that prepare an environmental assessment to analyze PWC use alternatives and then select an alternative to continue such use must draft a special regulation to authorize that use in the future.

PURPOSE OF AND NEED FOR ACTION

The purpose of and the need for taking action is to evaluate a range of alternatives and strategies for managing PWC use at Amistad National Recreation Area in order to ensure the protection of park resources and values while offering recreational opportunities as provided for in the national recreation area's enabling legislation, purpose, mission, and goals. Upon completion of the NEPA process, the National Park Service may either take action to adopt special NPS regulations by November 2002 to

manage PWC use at this park unit, or it may discontinue PWC use, as allowed for in the March 2000 rule.

This environmental assessment evaluates three alternatives concerning the use of personal watercraft at Amistad National Recreation Area. The alternatives include:

- *Alternative A* — Continue PWC use under a special NPS regulation in accordance with NPS *Management Policies 2001,* park practices, and state regulations.
- *Alternative B* — Continue PWC use under a special regulation but specifying limits and zones.
- *No-Action Alternative* — Eliminate PWC use entirely.

SCOPE OF THE ANALYSIS

Motorboats and other watercraft have been used at Amistad since the reservoir was first filled; PWC use emerged only since their introduction in the 1980s. While some effects of PWC use are similar to those of other motorcraft, and are therefore difficult to distinguish, the focus of this action is in support of decisions and rulemaking specific to PWC use. However, while the settlement agreement and need for action have defined the scope of this environmental assessment, the National Environmental Policy Act requires an analysis of cumulative effects on resources of all past, present, and reasonably foreseeable actions when added to the effects of the proposal (40 CFR 1508.7, 2000). The scope of this analysis, therefore, is to define management alternatives specific to PWC use, in consideration of other uses, actions, and activities cumulatively affecting park resources and values.

PURPOSE AND SIGNIFICANCE OF AMISTAD NATIONAL RECREATION AREA

Congress establishes national park system units to fulfill specified purposes, based on a park's unique and significant resources. A park's purpose, as established by Congress, is the fundamental building block for its decisions to conserve resources while providing for the "enjoyment of future generations."

LEGISLATIVE INTENT

The law creating Amistad National Recreation Area mandated the National Park Service to:

- provide for public outdoor recreation use and enjoyment of the lands and waters associated with the United States portion of the reservoir known as Lake Amistad, located on the boundary between the State of Texas and Mexico
- protect the scenic, scientific, cultural, and other value contributing to the public enjoyment of such lands and waters
- protects resources in a transition zone of three major biotic communities — Chihuahuan desert from the west, Edwards Plateau to the north, and Tamaulipan shrubland to the south and east

Amistad National Recreation Area
Texas

Location

United States Department of the Interior / National Park Service WASO / Nov. '02 / 621/20036

- Campground
- Group campground
- Ranger station
- Picnic area
- Nature trail
- Marina
- Boat launch
- Swimming area (unsupervised)
- Scuba diving

PURPOSE OF AMISTAD NATIONAL RECREATION AREA

The purpose of Amistad National Recreation Area is to provide visitors and neighbors with opportunities and resources for safe, high-quality public outdoor recreation and use of Lake Amistad; to develop and maintain facilities necessary for the care and accommodation of visitors; and to support the concepts of resources stewardship and protection and environmental sustainability by practicing and interpreting their application in a unit of the national park system.

SIGNIFICANCE OF AMISTAD NATIONAL RECREATION AREA

According to Amistad's 2001–2005 strategic plan, the primary significance of Amistad National Recreation Area can be summarized as:

- offers diverse water-based recreational opportunities, especially fishing
- interprets exceptional examples of Lower Pecos archeology and rock art
- commemorates a water conservation partnership between the United States and Mexico

BACKGROUND

NPS ORGANIC ACT AND MANAGEMENT POLICIES

The National Park Service Organic Act of 1916 directs the U.S. Department of the Interior and the National Park Service to manage units of the national park system "to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (16 USC 1). The Redwood National Park Expansion Act of 1978 reiterates this mandate by stating that the National Park Service must conduct its actions in a manner that will ensure no "derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress" (16 USC 1 a-1).

Despite these mandates, the Organic Act and its amendments afford the National Park Service latitude when making resource decisions that balance visitor recreation and resource preservation. Through these acts Congress "empowered [the National Park Service] with the authority to determine what uses of park resources are proper and what proportion of the parks resources are available for each use" (*Bicycle Trails Council of Marin v. Babbitt,* 82 F.3d 1445, 1453 (9th Cir. 1996)).

However, courts have consistently interpreted the Organic Act and its amendments to elevate resource conservation above visitor recreation. *Michigan United Conservation Clubs v. Lujan,* 949 F.2d 202, 206 (6th Cir. 1991) states, "Congress placed specific emphasis on conservation." The *National Rifle Ass'n of America v. Potter,* 628 F. Supp. 903, 909 (D.D.C. 1986) states, "In the Organic Act Congress speaks of but a single purpose, namely, conservation." The NPS *Management Policies* also recognize that resource conservation takes precedence over visitor recreation. The policy dictates that "when there is a conflict between conserving resources and values and providing for enjoyment of them, conservation is to be predominant" (NPS *Management Policies 2001,* sec. 1.4.3).

Because conservation remains predominant, the National Park Service seeks to avoid or to minimize adverse impacts on park resources and values. However, the Park Service has discretion to allow negative impacts when necessary (*Management Policies 2001,* sec. 1.4.3). While some actions and activities cause impacts, the National Park Service cannot allow an adverse impact that constitutes a

resource impairment (*Management Policies 2001,* sec. 1.4.3). The Organic Act prohibits actions that permanently impair park resources unless a law directly and specifically allows for the acts (16 USC 1 a-1). An action constitutes an impairment when its impacts "harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values" (*Management Policies 2001,* sec. 1.4.4). To determine impairment, the National Park Service must evaluate "the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts" (*Management Policies 2001,* sec. 1.4.4).

Because park units vary based on their enabling legislation, natural resources, cultural resources, and missions, the recreational activities appropriate for each unit and for areas within each unit vary as well. An action appropriate in one unit may impair resources in another unit. Thus, this environmental assessment analyzes the context, duration, and intensity of impacts related to PWC use at Amistad National Recreation Area, as well as the potential for resource impairment, as required by *Director's Order #12: Conservation Planning, Environmental Impact Analysis and Decision-making* (DO #12).

SUMMARY OF AVAILABLE RESEARCH ON THE EFFECTS OF PERSONAL WATERCRAFT

Over the past two decades PWC use in the United States increased dramatically. However, there are conflicting data about whether PWC use is continuing to increase. While the National Transportation Safety Board (NTSB) estimates that retailers sell approximately 200,000 personal watercraft each year and people currently use another 1 million (NTSB 1998), the PWC industry argues that PWC sales have decreased by 50% from 1995 to 2000 (American Watercraft Association [AWA] 2001). National PWC ownership increased every year between 1991 and 1998; the rate of annual increase peaked in 1994 at 32% and dropped slightly in 1999 and 2000 (see Table 1). In 2001 there were 1,053,560 PWC, a 2.4% decrease from 2000 (National Marine Manufacturers Association 2002).

TABLE 1: NATIONAL PWC REGISTRATION TREND

Year	No. of Boats Owned	Boat Ownership Trend (Percentage Change)	No. of Personal Watercraft Owned*	PWC Ownership Trend (Percentage Change)
1991	16,262,000	--	305,915	--
1992	16,262,000	0%	372,283	21.7%
1993	16,212,000	0%	454,545	22.1%
1994	16,239,000	0%	600,000	32.0%
1995	15,375,000	-5%	760,000	26.7%
1996	15,830,000	3%	900,000	18.4%
1997	16,230,000	3%	1,000,000	11.1%
1998	16,657,000	3%	1,100,000	10.0%
1999	16,773,000	1%	1,096,000	-0.4%
2000	16,965,000	1%	1,078,400	-1.6%
2001			1,053,560	-2.4%

Sources: M. Schmidt, USCG, e-mail comm., September 4, 2001; National Marine Manufacturers Association.

* Estimates provided by the National Marine Manufacturers Association (M. Schmidt, USCG, pers. comm., Sept. 4, 2001).

The majority of personal watercraft used today are powered by conventional two-stroke engines (NPS 1998a; California Air Resources Board [CARB] 1999). Multiple studies have demonstrated that four-stroke engines are substantially cleaner than carbureted, two-stroke engines, generating approximately 90% fewer emissions (British Columbia Ministry of Water, Land and Air Protection 1993; Oregon Department of Environmental Quality [ODEQ] 1999; TRPA 1999). The Personal Watercraft Industry Association (PWIA) notes that direct-injection engines have been available in personal watercraft for four years, and three PWC manufacturers introduced four-stroke engines for the 2002 model year

(PWIA to NPS, May 28, 2002, re: comment on *Lake Mead National Recreation Area Lake Management Plan and Draft Environmental Impact Statement)*. The U.S. Environmental Protection Agency assumes that the existing two-cycle engine models would not be completely replaced by newer PWC technology until 2050 (40 CFR 89, 90, 91).

The average operating life of a personal watercraft is 5 to 10 years, depending on the source. The formula for determining the operating life of personal watercraft was published in the *Federal Register* on October 4, 1996 (US EPA 1996a). Based on this formula, the National Park Service expects that by 2012 most boat owners will already be in compliance with the 2006 EPA marine engine standards. The Personal Watercraft Industry Association believes that the typical operating life of a personal watercraft rental is 3 years and of a privately owned vessel approximately 5 to 7 years (PWIA to NPS, May 28, 2002, comment on *Lake Mead National Recreation Area Lake Management Plan and Draft Environmental Impact Statement*).

Environmental groups, land managers, and PWC users and manufacturers express differing opinions about the environmental consequences of PWC use, and about the need to manage or to limit this recreational activity. Various research studies conducted on the effects of PWC use in general are summarized below for water pollution, air pollution, noise, wildlife, vegetation and shoreline erosion, and health and safety.

Water Pollution

Two-stroke, carbureted engines discharge as much as 30% of their fuel directly into the water (NPS 1999b; CARB 1999). Hydrocarbons, including benzene, toluene, ethylbenzene, and xylene (BTEX) and polyaromatic hydrocarbons (PAHs), are also released, as well as methyl tertiary-butyl ether (MTBE) in states that use this additive. The amount of pollution correctly attributed to PWC use compared to other motorboats and the degree to which PWC use affects water quality remains debatable. As noted in a report by the Oregon Department of Environmental Quality, every waterbody has different conditions (e.g., water temperature, air temperatures, water mixing, motorboating use, and winds) that affect the pollutants' impacts (ODEQ 1999).

A recent study conducted by the California Air Resources Board consisted of a laboratory test designed to comparatively evaluate exhaust emissions from marine and PWC engines, in particular two- and four-stroke engines (CARB 2001). The results of this study showed a difference in emissions (in some cases 10 times higher total hydrocarbons in two-stroke engines) between these two types of engines. An exception was air emissions of NO_x, which was higher in four-stroke than in two-stroke engines. Concentrations of pollutants (MTBE, BTEX) in the tested water were consistently higher for two-stroke engines.

In 1996 the Environmental Protection Agency promulgated a rule to control exhaust emissions from new marine engines, including outboard motors and personal watercraft (US EPA 1996a). As a result of the rule, the U.S. Environmental Protection Agency estimated an overall 52% reduction in hydrocarbon emissions from marine engines from present levels by 2010, and a 75% reduction by 2030, based on phasing out polluting machines. A 1997 EPA rule delayed implementation by one year (US EPA 1996a, 1997).

Discharges of MTBE and PAHs particularly concern scientists because of their potential to adversely affect the health of people and aquatic organisms. Scientists need to conduct additional studies on PAHs (Allen et al. 1998) and MTBE (NPS 1999b), as well as long-term studies on the effect of repeated exposure to low levels of these pollutants (Asplund 2001).

At Lake Tahoe, concern about the negative impact on lake water quality and aquatic life caused by the use of two-stroke marine engines led to at least 10 different studies relevant to motorized watercraft in the Tahoe Basin in 1997 and 1998. The results of these studies (Allen et al. 1998) confirmed that (1) petroleum products are in the lakes as a result of motorized watercraft operation, and (2) watercraft powered by carbureted two-stroke engines discharge pollutants at an order of magnitude greater than do watercraft powered by newer technology engines (TRPA 1999).

On June 25, 1997, the Tahoe Regional Planning Agency adopted an ordinance prohibiting the "discharge of unburned fuel and oil from the operation of watercraft propelled by carbureted two-stroke engines" beginning June 1, 1999. Following the release of an environmental assessment in January 1999, this prohibition was made permanent.

PAHs (which include benzo(a)pyrene, naphthalene, and 1-methyl naphthalene) are released during the combustion of fuel, although some PAHs are also found in unburned gasoline. PAHs, as well as other hydrocarbon emissions, will be reduced as new four-stroke engines replace older, carbureted two-stroke engines (Kado et al. 2000). The conversion of carbureted two-stroke engines would be an important step toward substantially reducing petroleum-related pollutants.

Some research shows that PAHs, including those from PWC emissions, adversely affect water quality by means of harmful phototoxic effects on ecologically sensitive plankton and other small water organisms (US EPA 1998; Oris et al. 1998; Landrum et al. 1987; Mekenyan et al. 1994; Arfsten et al. 1996). This in turn can affect aquatic life and ultimately aquatic food chains. The primary concern is in shallow water ecosystems.

Air Pollution

Personal watercraft emit various compounds that that pollute the air. In two-stroke engines commonly used in personal watercraft the lubricating oil is used once and is expelled as part of the exhaust; and the combustion process results in emissions of air pollutants such as nitrogen oxides (NO_x), volatile organic compounds (VOC), particulate matter (PM), and carbon monoxide (CO). In areas with high PWC use some air quality degradation likely occurs (US EPA 1996a, 2000). Kado et al. (2000) found that two-stroke engines had considerably higher emissions of airborne particulates and PAHs than four-stroke engines tested. Changing from two-stroke, carbureted engines to two-stroke direct-injected engines may result in increases of airborne-particulate associated PAHs (Kado et al. 2000). Further research is needed to identify what impact this would have on PAH concentrations in water. It is assumed that the 1996 EPA rule concerning marine engines will substantially reduce air emissions from personal watercraft in the future (US EPA 1996a).

In August 2002 the U.S. Environmental Protection Agency proposed additional rules that would further reduce boating emissions. The proposal includes evaporative emission standards for all boats and would reduce emissions from fuel tanks, etc., by 80% (67 FR 157 [Aug. 14, 2002]: 53049–115).

Noise

Noise levels emitted by PWC engines vary from vessel to vessel, depending on many factors. Some PWC industry literature states that all recently manufactured watercraft emit fewer than 80 decibels (dB) at 50 feet from the vessel, whereas some literature from public interest groups attribute levels as high as 102 dB without specifying distance. None of this literature adequately describes the methodology for collecting the data to determine those levels. Because of this, the National Park Service

contracted noise measurements of personal watercraft and other boat types in 2001 at Glen Canyon National Recreation Area; preliminary analysis of this data indicates maximum levels for PWC-generated noise at 82 feet (25 meters) of approximately 68 to 78 A-weighted dB (dBA). Other motorboat types were measured during that study at approximately 65 to 86 dBA at 82 feet (Harris Miller Miller & Hanson, Inc. 2002).

Regulations for boating and water use activities established by the National Park Service prohibit vessels from operating at more than 82 dB measured at 82 feet (25 meters) from the vessel (36 CFR 3.7). However, this regulation does not imply that there are no noise impacts from vessels operating below that limit. Noise impacts from PWC use are caused by a number of factors. Noise complaints against PWC use seem to focus as much or more on frequent changes in pitch and sound energy levels due to rapid acceleration, deceleration, jumping into the air, and change of direction, as on noise levels themselves. Noise from human sources, including personal watercraft, can intrude on natural soundscapes, masking the natural sounds that are an intrinsic part of the environment. This can be especially true in quiet places, such as in secluded lakes, coves, river corridors, and backwater areas. Also, PWC use in areas where there are nonmotorized users (such as canoeists, sailors, people fishing or picnicking, and kayakers) can disrupt the "passive" experience of park resources and values.

Komanoff and Shaw (2000) note that the biggest difference between noise from personal watercraft and that from motorboats is that the former continually leave the water, which magnifies noise in two ways. Without the muffling effect of water, the engine noise is typically 15 dBA louder, and the smacking of the craft against the water surface results in a loud "whoop" or series of them. With the rapid maneuvering and frequent speed changes, the impeller has no constant "throughput" and no consistent load on the engine. Consequently, the engine speed rises and falls, resulting in a variable pitch. This constantly changing sound is often perceived as more disturbing than the constant sound from motorboats.

PWC users tend to operate close to shore, to operate in confined areas, and to travel in groups, making noise more noticeable to other recreationists. Motorboats traveling back and forth in one area at open throttle or spinning around in small inlets also generate complaints about noise levels; however, most motorboats tend to operate away from shore and to navigate in a straight line, thus being less noticeable to other recreationists (Vlasich 1998).

Research conducted by the Izaak Walton League (IWL) indicates that one PWC unit can emit between 85 and 105 dB of sound, and that wildlife or humans located 100 feet away may hear sounds of 75 dB. This study also stated that rapid changes in acceleration and direction may create a greater disturbance and emit sounds of up to 90 dB (IWL 1999). Other studies conducted by the New Jersey State Police indicate that a PWC unit with a 100-horsepower (hp) engine emits up to 76 dBA, while a single, 175-hp outboard engine emits up to 81 dBA. The Personal Watercraft Industry Association believes that through the year 2002, most PWC output is between 155 and 165 hp (PWIA e-mail to NPS, Sept. 23, 2002).

Sea-Doo research indicates that in three out of five distances measured during a sound level test, PWC engines were quieter than an outboard motorboat. Sea-Doo also found that it would take approximately four personal watercraft operating 50 feet from shore produce 77 dBA, and it would take 16 personal watercraft operating 15 feet from shore to emit 83 dBA of sound, which is equal to one open exhaust boat at 1,600 feet from shore. In response to public complaints, the PWC industry has employed new technologies to reduce sound by about 50% to 70% on 1999 and newer models (Sea-Doo 2000; Hayes 2002). Additionally, by 2006 the EPA requirements will reduce PWC noise, in association with improvements to engine technology (US EPA 1996b). EPA research also indicates

that one PWC unit operating 50 feet from an onshore observer emits a sound level of 71 dBA, and studies conducted using the Society of Automotive Engineers (2001) found that two PWC units operating 50 feet from shore emit similar sound levels of about 74 dBA (PWIA 2000).

Most studies on the effects of noise on soundscapes and human receptors have focused on highway and airport noise. Komanoff and Shaw (2000) used the analytical approaches of these studies to perform a noise-cost analysis of personal watercraft. They concluded that the cost to beachgoers from PWC noise was more than $900 million per year. The cost per personal watercraft was estimated to be about $700 each year or $47 for each three-hour "personal watercraft day." They further concluded that the cost per beachgoer was the highest at secluded lake sites, because beachgoers likely had a higher expectation of experiencing natural quiet and usually invested a larger amount of time and personal energy in reaching the area. However, because many more visitors are affected at popular beaches, noise costs per personal watercraft were highest at crowded sites (*Drowning in Noise: Noise Costs of Jet Skis in America* [Komanoff and Shaw 2000]).

Wildlife Impacts

Although relatively few studies have specifically examined PWC effects on wildlife, several researchers have documented wildlife disturbances from personal watercraft and motorboats. A study recently completed in Florida examined the distance at which waterbirds are disturbed by both personal watercraft and outboard-powered boats (Rodgers and Schwikert 2002). Flush distances varied from 65 to 160 feet for personal watercraft, and flush distances for most species were greater for motorboats than for personal watercraft 80% of the time. The authors note that PWC use may be more threatening to waterbirds since PWC users can navigate in shallow secluded waterways where birds typically eat and rest. Burger (2000) examined the behavior of common terns in relation to PWC use and other boats and noted that PWC users traveled faster and came closer to banks, resulting in more flight response in terns and contributing to lower reproductive success.

Shoreline Vegetation

The effects of PWC use on aquatic communities have not been fully studied, and scientists disagree about whether PWC use adversely impacts aquatic vegetation. The majority of concern arises from the shallow draft of personal watercraft, which allows access to shallow areas that conventional motorboats cannot reach. Like other vessels, personal watercraft may destroy grasses that occur in shallow water ecosystems. Anderson (2000) studied the effect of PWC wave-wash on shallow salt marsh vegetation and found that although the waves from personal watercraft are not different from those generated by other boats, personal watercraft can enter marsh channels and create sediment suspension problems in these areas.

Erosion Effects

Some studies have examined the erosion effects of personal watercraft waves, and other studies suggest that personal watercraft may disturb sediments on river or lake bottoms and cause turbidity. Conflicting research exists concerning whether PWC-caused waves result in erosion and sedimentation. PWC-generated waves vary in size depending on the environment, including weight of the driver, number of passengers, and speed. Anderson (2000) studied the effect of PWC wave-wash on shallow salt marsh vegetation and found that although the waves from personal watercraft are not different

from those generated by other boats, personal watercraft can enter marsh channels and create sediment suspension problems in these areas.

Health and Safety Concerns

Industry representatives report that PWC accidents decreased in some states in the late 1990s. The National Transportation Safety Board reported that in 1996 personal watercraft represented 7.5% of state-registered recreational boats but accounted for 36% of recreational boating accidents. In the same year PWC operators accounted for more than 41% of people injured in boating accidents. PWC operators accounted for approximately 85% of the persons injured in accidents studied in 1997 (NTSB 1998).

Increased PWC use in recent years has resulted in more concern about the health and safety of operators, swimmers, snorkelers, divers, and other boaters. The NTSB study revealed that while recreational boating fatalities have been declining in recent years, PWC-related fatalities have increased (NTSB 1998). Nationwide PWC accident statistics provided by the U.S. Coast Guard supports the increase in PWC-related fatalities (see Table 2). However, since a peak of 84 PWC-related fatalities in 1997, accidents, injuries, and fatalities involving personal watercraft have decreased (M. Schmidt, U.S. Coast Guard [USCG], pers. comm., Sept. 4, 2001). The U.S. Coast Guard's Office of Boating Safety studied exposure data to assess boating risks. This method allows for a comparison between boat types based on comparable time in the water. PWC use ranked second in boat type for fatalities per million hours of exposure in 1998, with a 0.24 death rate per million exposure hours.

TABLE 2: NATIONWIDE PWC ESTIMATES AND ACCIDENT STATISTICS

Year	Recreational Boats Owned*	PWC Owned*	No. of PWC in Accidents	No. of PWC Injuries	No. of PWC Fatalities	No. of All Boats Involved in Accidents	Percentage of PWC Involved in Accidents
1987	14,515,000	N/A	376	156	5	9,020	4.2
1988	15,093,000	N/A	650	254	20	8,981	7.2
1989	15,658,000	N/A	844	402	20	8,020	10.5
1990	15,987,000	N/A	1,162	532	28	8,591	13.5
1991	16,262,000	305,915	1,513	708	26	8,821	17.2
1992	16,262,000	372,283	1,650	730	34	8,206	20.1
1993	16,212,000	454,545	2,236	915	35	8,689	25.7
1994	16,239,000	600,000	3,002	1,338	56	9,722	30.9
1995	15,375,000	760,000	3,986	1,617	68	11,534	34.6
1996	15,830,000	900,000	4,099	1,837	57	11,306	36.3
1997	16,230,000	1,000,000	4,070	1,812	84	11,399	35.7
1998	16,657,000	1,100,000	3,607	1,743	78	11,368	31.7
1999	16,773,000	1,096,000	3,374	1,614	66	11,190	30.2
2000	16,965,000	1,078,400	3,282	1,580	68	11,079	29.6
Total			**33,851**	**15,238**	**645**		

Source: M. Schmidt, USCG, e-mail comm., Sept. 4, 2001.
*Estimates provided by the National Marine Manufacturers Association (M. Schmidt, USCG, pers. comm., Sept. 4, 2001).
N/A: Not Available.

Since PWC operators can be as young as 12 in several states, accidents can involve children. The American Academy of Pediatrics (2000) recommends that no one younger than 16 operate personal watercraft.

Some manufacturing changes on throttle and steering may reduce potential accidents. For example, on more recent models, Sea-Doo developed an off-power assisted steering system that helps steer during

off-power as well as off-throttle situations. This system, according to company literature, is designed to provide additional maneuverability and improve the rate of deceleration (Sea-Doo 2001a).

PWC USE AND REGULATION AT AMISTAD NATIONAL RECREATION AREA

The park began regularly documenting PWC use on July 4, 1992, but the earliest record is from March 1989, when a violation notice was issued to an operator for reckless and negligent behavior near a swim beach. PWC use became more common between 1990–91, and in May 2001 park staff began collecting more specific PWC use data. The highest use generally occurs in summer from Friday through Sunday, and in 2001 ranged from as low as 1 personal watercraft to 35. Park staff believe that PWC use is increasing at approximately 1.5% per year (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 19, 2002). Data collected at the reservoir show that PWC users are a consistent part of Amistad's total boating population. Details are provided under "PWC Use" in the "Affected Environment" section.

OBJECTIVES IN TAKING ACTION

Objectives define what must be achieved for an action to be considered a success. Alternatives selected for detailed analysis must meet all objectives and must also resolve purpose of and need for action.

Using the park's enabling legislation, mandates and direction in other planning documents, such as the park's 1987 *General Management Plan* and the 2001–2005 *Strategic Plan,* issues, and servicewide objectives, park staff identified the following management objectives relative to PWC use:

WATER QUALITY

- Manage PWC emissions in accordance with antidegradation policies and goals.
- Protect plankton and other aquatic organisms from PWC emissions and sediment disturbances so that the viability of dependent species is conserved.

AIR QUALITY

- Manage PWC activity so that air emissions of harmful compounds do not appreciably degrade ambient air quality.

SOUNDSCAPES

- Manage noise from PWC use so that visitors' health, safety, and experiences are not adversely affected.

WILDLIFE AND WILDLIFE HABITAT

- Protect birds, waterfowl, and other wildlife from the effects of PWC noise, especially during nesting seasons.
- Protect fish and wildlife and their habitats from PWC disturbances.

- Protect fish and wildlife from the adverse effects that result from the bioaccumulation of contaminants emitted from personal watercraft.

THREATENED, ENDANGERED, AND SPECIAL CONCERN SPECIES

- Protect threatened and endangered species and their habitats from PWC disturbances.

SHORELINE VEGETATION

- Manage PWC use to protect environmentally sensitive shoreline vegetation from PWC activity and access.
- Manage PWC use to protect environmentally sensitive shoreline areas from any potential erosion caused by PWC activity.

VISITOR EXPERIENCE

- Manage the potential for conflicts between PWC use and park visitors.

VISITOR CONFLICTS AND SAFETY

- Minimize or reduce the potential for PWC user accidents.
- Minimize or reduce the potential for safety conflicts between PWC users and other water recreationists.
- Provide a safe and healthful environment for park visitors.
- Minimize and reduce the potential for PWC access to areas that have limited ability for rescue capabilities.

CULTURAL RESOURCES

- Manage PWC use and access to protect cultural resources.

SOCIOECONOMICS

- Work cooperatively with concessioners and local businesses that rent or sell personal watercraft.

NATIONAL RECREATION AREA MANAGEMENT AND OPERATIONS

- Provide a safe and healthful environment for park visitors.
- Minimize and reduce the potential for PWC access to areas that have limited ability for rescue capabilities.
- Seek cooperation with local and state agencies that manage or regulate PWC use, as well as with international agencies.

ISSUES AND IMPACT TOPICS

Issues associated with PWC use at the park were identified during scoping meetings with NPS staff and as a result of public comments. Many of these issues were identified in the settlement agreement with the Bluewater Network, which requires that at a minimum the effects of PWC use be analyzed for the following: water quality, air quality, soundscapes, wildlife and wildlife habitat, shoreline vegetation, visitor conflicts, and visitor safety. Potential impacts to other resources were considered as well. The following impact topics are discussed in the "Affected Environment" chapter and analyzed in the "Environmental Consequences" chapter. If no impacts are expected, based on available information, then the issue was eliminated from further discussion, as explained on page 20.

WATER QUALITY

The majority of personal watercraft in use today are powered by conventional two-stroke, carbureted engines, which discharge as much as 30% of their fuel directly into the water (NPS 1999b; CARB 1999). New technology and implementation of EPA's 2006 emission requirements are designed to reduce water quality impacts. Hydrocarbons, including BTEX, are also released, as well as MTBE. These discharges could have potential adverse effects on water quality at Amistad National Recreation Area.

Some research shows that PAHs, including those from PWC emissions, adversely affect water quality by means of harmful phototoxic effects on ecologically sensitive plankton and other small water organisms (US EPA 1998; Oris et al. 1998; Landrum et al. 1987; Mekenyan et al. 1994; Arfsten et al. 1996). This in turn can affect aquatic life and ultimately aquatic food chains. The primary concern is in shallow water ecosystems.

Even though MTBE is not used in Texas, the park's proximity to other states and Mexico means that MTBE could enter park waters if PWC operators purchase gasoline outside Texas. The Rio Conchos, which enters the Rio Grande from Mexico approximately 40 miles north of Big Bend, is a known pollutant (primarily agricultural pesticides), which could affect Amistad's waters.

Amistad reservoir is not a direct drinking water source, although Ciudad Acuña in Mexico does draw drinking water from the Rio Grande six miles downstream of the dam. No one has the legal right to draw water directly from the reservoir for any purpose. However, wells near the reservoir might pull water from fractures in the limestone.

AIR QUALITY

Pollutant emissions such as nitrogen oxides and volatile organic compounds from PWC use may adversely affect air quality. Although air quality within the park is currently good and meets state standards at Amistad National Recreation Area, PWC emissions could have some localized impacts, particularly if PWC use increased. New technology and implementation of EPA's 2006 emission requirements are designed to reduce some air quality impacts. Air contaminants from Texas sources and possibly from coal-fired plants in Mexico (particularly in Nava, approximately 70 miles southeast of Amistad and south of Piedras Negras) could degrade air quality. Ciudad Acuña also has manufacturing plants, a tire testing facility, and a municipal dump, which may affect air quality.

SOUNDSCAPES

PWC-generated noise varies from vessel to vessel. Some literature states that all recently manufactured watercraft emit fewer than 80 dB at 50 feet from the vessel, while other sources attribute levels as high as 102 dB without specifying distance. None of this literature fully describes the method used to collect noise data.

The National Park Service contracted for noise measurements of personal watercraft and other motorized vessels in 2001 at Glen Canyon National Recreation Area (Harris Miller Miller & Hanson, Inc. 2002). The results show that maximum PWC noise levels at 50 feet ranged from 68 to 76 dBA. Noise levels for other motorboat types measured during that study ranged from 65 to 86 dBA at 50 feet.

Noise limits established by the National Park Service require vessels to operate at less than 82 dB at 82 feet from the vessel. Personal watercraft may be more disturbing than other motorized vessels because of rapid changes in acceleration and direction of noise. Lake levels at Lake Amistad fluctuate greatly, and have been falling since 1994. These fluctuations can alter the distance PWC operate from other visitors, such as shoreline campers and residents who live in subdivisions near the shore. In addition, the flooded reservoir includes arms of rivers, such as the Devils River, which is narrower than the main reservoir body, forcing PWC users to ride closer together, potentially increasing sound levels. Residents who live in the subdivisions near the shoreline occasionally complain about PWC noise.

WILDLIFE AND WILDLIFE HABITAT

PWC use may impact wildlife activities, causing alarm or flight, avoidance of habitat, and effects on reproductive success. This is thought to be caused by PWC speed, noise, and access, and personal watercraft may have a greater impact on wildlife than other types of watercraft. The park has no documented records or undocumented observations of PWC collisions with wildlife or of PWC users harassing wildlife (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Nov. 5, 2002, re: wildlife).

THREATENED, ENDANGERED, AND SPECIAL CONCERN SPECIES

PWC use is believed to cause harm to threatened and endangered species because the machine's engine, submerged under the water, muffles the 'warning' sounds that some species depend on to escape from imminent danger. One federally listed species, the interior least tern, arrives each spring to nest at Amistad and leaves the area by late August. The park already implements a plan for protecting the interior least tern, which appears to be bothered by PWC use only if users beach and walk on nesting islands. The beaver is a listed species in Mexico and the Rio Grande (half of which is managed by Mexico), and it does occur in Amistad. Other federal and state listed species are occasionally seen in the national recreation area, but these occurrences are thought to be accidental or migratory visitors.

SHORELINE VEGETATION

PWC operators may disembark from their craft to visit along the shore. These visitors may trample upland vegetation along the shoreline in order to access trails or to explore along the shore. However, Amistad's fluctuating lake levels have killed most of the native shoreline vegetation, and nonnative species have moved into the shoreline area. In addition, many areas of the shoreline also consist of 200-foot high vertical limestone cliffs. Park staff have observed PWC wakes that reach the shoreline;

however, reservoir fluctuations and wind appear to be the primary causes of impacts to shoreline vegetation.

No other wave action studies have been conducted. According to the "Superintendent's Compendium," vessels are prohibited from operating within harbors, mooring areas, and any no-wake areas marked by buoys in excess of wake speed.

VISITOR EXPERIENCE

PWC use is viewed by some segments of the public as a nuisance due to their noise, speed, and overall environmental effects. Others believe that personal watercraft are no different from other motorized watercraft and that people have a right to enjoy the sport. According to NPS *Management Policies*, the National Park Service will preserve, to the greatest extent possible, the natural soundscapes of parks. The primary concern involves changes in noise, pitch, and volume due to the way in which personal watercraft are operated. Additionally, the sound of any watercraft can carry for long distances, especially on a calm day.

Bass fishing is very popular at Amistad, and tournaments occur nearly every weekend year-round. Some anglers have complained about PWC use. Very few nonmotorized boat users visit the reservoir.

VISITOR CONFLICTS AND SAFETY

Industry representatives report that PWC accidents decreased in some states in the late 1990s. The National Transportation Safety Board reported that in 1996 personal watercraft represented 7.5% of state-registered recreational boats but accounted for 36% of recreational boating accidents. In the same year PWC operators accounted for more than 41% of people injured in boating accidents. PWC operators accounted for approximately 85% of the persons injured in accidents studied in 1997 (NTSB 1998). PWC speeds, wakes, and proximity to other users can pose conflicts and hazards to other recreationists. At Amistad, swimmers have complained about PWC coming too close to swim beaches. Several new unofficial swim beaches have formed due to lowering lake levels, and these swim areas are in prime PWC use locations. However, the decreasing lake levels have also lead to a decrease in the number of swimmers.

Bass anglers and PWC use the same launch areas, which can become congested, especially during fishing tournaments. There is potential for conflicts or accidents in these areas, although none have been document by park staff.

Personal watercraft are able to access shallow water areas where most other motorcraft cannot go, which may limit search-and-rescue operations.

Because the park shares a border with Mexico, park staff must consider national issues related to PWC use. PWC users could potentially launch in Mexico to access the reservoir and possibly U.S. park waters. For example, if the park banned two-stroke engines, two-stroke engines could still have access to the reservoir from Mexico. Park staff have no jurisdiction in Mexican waters. Any decisions regarding PWC use in the park will affect only the U.S. side of the reservoir. The park is unaware of any PWC regulations or rules defined by Mexico (G. Garetz and D. Larson, NPS, pers. comm., P. Steinholtz, URS, Aug. 14, 2002).

CULTURAL RESOURCES

Cultural resources that are listed, or may be eligible for listing, on the National Register of Historic Places, may be affected by PWC use. Specifically, shoreline erosion and uncontrolled visitor access may affect the resources since riders are able to access / beach / launch in areas less accessible to most motorcraft.

The Amistad region contains one of the densest concentrations of archaic pictographic rock art in the U.S. and one of the longest continuous records of human occupation in North America. Archeological research prior to the construction of Amistad Dam established the existence of literally hundreds of prehistoric pictograph and archeological sties. Over 400 archaeological sites within or near the national recreation area have been documented. Falling lake levels have exposed some of these previously inundated archeological sites, which the park has begun surveying and documenting. Boaters have been "exploring" recently exposed archeological and historical sites around the reservoir, but the park has not been able to quantify the exact amount of damage that is recurring as a result (J. Labadie, NPS, pers. comm., P. Steinholtz, URS, Oct. 1, 2002, re: accessible rock art). The park has developed only Parida and Panther Cave for access by water (boat or PWC).

Wave action studies were conducted in relationship to effects on cultural resources, and most water-related damage to archeological sites is caused by wave action. Winds are responsible for most of the wave action damage to cultural sites, especially during the winter, when winds upwards of 50 mph can cause major damage to sites along the southern shoreline (J. Labadie, NPS, pers. comm., P. Steinholtz, URS, Nov. 1, 2002, re: wave action).

SOCIOECONOMIC ENVIRONMENT

National PWC ownership increased every year between 1991 and 1998; the rate of annual increase peaked in 1994 at 32% and dropped slightly in 1999 and 2000 (see Table 1). In 2001 there were 1,053,560 PWC, a 2.4% decrease from 2000 (National Marine Manufacturers Association 2002). Alternatives affecting PWC use could have an effect on businesses that cater to PWC users.

PARK MANAGEMENT AND OPERATIONS

Impact to Park Operations from Increased Enforcement Needs

PWC use may require additional park staff to enforce standards, limits, or closures because of their increased accident rates and visitor conflicts. NPS park rangers and the Texas Parks and Wildlife Department (TPWD) game wardens are the only law enforcement officers enforcing the Texas state boating regulations, which are consistent with the NPS regulations, at Amistad (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Nov. 5, 2002, re: enforcement).

Conflict with State and Local Ordinances and Policies Regarding PWC Use

Some national, state, and local governments have taken action, or are considering taking action, to limit, ban, or otherwise manage PWC use. While the park may be exempt from local actions, consistency with national, state, and local plans must be evaluated. No issues or conflicts would exist between Texas regulations and actions described under the alternatives being considered. At Amistad National Recreation Area, no local jurisdictions are considering additional measures to regulate PWC

use. As mentioned above, NPS park rangers and the TPWD game wardens are the only law enforcement officers enforcing the Texas state boating regulations at Amistad (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Nov. 5, 2002, re: enforcement).

ISSUES ELIMINATED FROM FURTHER CONSIDERATION

The following issues were eliminated from further analysis for the reasons stated below.

Ethnographic Resources, Sacred Sites/Native American Concerns (Native American Graves Protection and Repatriation Act) — At the present time, no Native American groups have expressed an interest in the management of ethnographic resources at Amistad National Recreation Area, nor has any group requested participation in environmental management issues at the park. The park initiated ethnohistoric research in the mid 1990s to identify potentially affiliated Native American groups residing in the United States. This research was finally completed and published in late 2002 as an "Ethnohistoric Literature Review," which will form the basis for a future ethnographic affiliation study (Kenmotsu and Wade 2002).

Historic Structures/Buildings — Only one historic structure has been documented within the national recreation area and is located within the Seminole Canyon National Historic District. This site is not located near the reservoir shoreline and will not be specifically affected by PWC use.

Museum Collections — Although the Amistad National Recreation Area maintains a museum collection of over one million objects, these materials are housed in a protective environment and are not specifically affected by PWC use.

Cultural Landscapes — Cultural landscapes have not been designated or identified at Amistad National Recreation Area; therefore, this resource type will not be affected by PWC use.

Wetlands — Any potential impacts to wetlands in the vicinity of the shoreline are evaluated under the topic "Shorelines and Shoreline Vegetation." (The extent of the area of impact is defined in the methodology section for shoreline vegetation.) Wetlands that occur farther inland would not be affected by PWC use because of the limited distance that PWC users generally walk when not using their machines.

Floodplains — The level of PWC use and associated PWC activities identified in each alternative would have no adverse impacts on floodplains. No development is proposed in the alternatives; thus, no flooding would occur as a result of PWC use and cause impacts to human safety, health, or welfare.

Prime and Unique Agricultural Lands — No prime and unique agricultural farmland exists in the vicinity of areas that would be affected by PWC use.

Energy Requirements and Natural or Depletable Resource Requirements — PWC operation requires the use of fossil fuels. While PWC use could be limited or banned within this park unit, no alternative considered in this environmental assessment would affect the number of personal watercraft used within the region or the amount of fuel that is consumed. The level of PWC use considered in this environmental assessment is minimal. Fuel is not now in short supply, and PWC use would not have an adverse effect on continued fuel availability.

Impacts to Economically Disadvantaged or Minority Populations (Executive Order 12898)— Local residents may include low-income populations. However, these populations would not be particularly or disproportionately affected by continuing or discontinuing PWC use. Other

areas near the park, including Mexico (which has jurisdiction over and manages half of the reservoir) are available to all PWC users. There are no small business owners in the Amistad area who rent personal watercraft as a primary source of income. Park actions would not disproportionately affect minority or low-income populations. This issue was dismissed from further analysis for the following reasons:

1. Personal watercraft are used by a cross section of ethnic groups and income levels.
2. Other areas are available and open to personal watercraft and are used by all ethnic groups and income levels.
3. NPS actions would not disproportionately affect minority or low-income populations.
4. Any NPS actions to limit PWC use would not displace PWC use to low-income or ethnically sensitive areas.

RELATIONSHIP TO OTHER PLANS, POLICIES, AND ACTIONS

The following plans, policies, and actions could affect the alternatives being considered for personal watercraft. These plans and policies are also considered in the analyses of cumulative effects.

PARK POLICIES, PLANS, AND ACTIONS

General Management Plan

The park currently manages PWC use through its *General Management Plan* and the "Superintendent's Compendium." PWC use is not specifically addressed in the park's current *General Management Plan*, approved in 1987. However, personal watercraft were intended to be treated as another type of motorized watercraft. The *General Management Plan* makes the following statements about boating activities:

> Most of the regional needs for fishing, scuba diving, boating, swimming, picnicking, camping, and hunting are met by Amistad Recreation Area ("Brief Description and Significance").
>
> The recreation area will continue to provide for present uses (boating, fishing, swimming, camping, picnicking, scuba diving, and hunting) and will accommodate new recreational activities when they are compatible with existing uses and are within staff capabilities — including volunteers — to manage effectively ("General Development and Visitor Use: Activities and Capacities").

Section 3.24 in the "Superintendents' Compendium" addresses PWC use as follows:

> (b) Designation of areas for personal watercraft use requires the promulgation of special regulations, except for the following areas: Amistad, . . . where personal watercraft use may be designated using the procedures of Section 1.5 and 1.7 of this chapter until November 6, 2002.

A program is underway to revise the *General Management Plan*. The team will examine the park's facilities and discuss the need for or the possibility of providing additional boat ramps, access points, campgrounds, picnic areas, etc. This is expected to be a three-year process, and it is too early to predict what, if any, changes will be made to park facilities.

Other Policies, Plans, and Actions

The park's *Strategic Plan* contains a long-term goal of completing 10% of the natural resource inventories, studies, and planning documents listed in its *Resource Management Plan* and *General Management Plan*, such as the "Water Resources Scoping Report" (completed) and a cooperative fisheries management plan.

The park currently has no plans to build additional boat ramps or access roads to the lake, which would result in an increase in visitor access and a possible increase in overall visitation. The park replaced an existing boat ramp at Box Canyon, allowing four boats to launch at once instead of only one.

Lake Amistad Marina and Rough Canyon Marina are private operators on Lake Amistad. The U.S. Air Force also operates South Winds Marina, of which only the boat ramp and parking area are open to the public. No information was available as to future plans that these marinas may have (see the "Impact Topics" section for more details and contact information).

LOCAL OR STATE POLICIES, PLANS, OR ACTIONS

No local actions or laws have been established by the City of Del Rio or Val Verde County that affect PWC use at Amistad National Recreation Area. There are regional long-term plans to build truck bypasses around Del Rio; the proposed alignment of the northside loop may come near present park headquarters. Proposed construction is expected to be completed by approximately 2012. The park is not aware of other plans or activities proposed or underway in the region.

ALTERNATIVES

All alternatives must be consistent with the purpose and significance of Amistad National Recreation Area, and they must meet the purpose of and need for action, as well as the objectives for the project. Three alternatives are described in this section, as well as alternatives that were considered but dismissed.

The alternatives, which are analyzed in accordance with the National Environmental Policy Act, are the result of agency and public scoping input, as stipulated in the settlement agreement between the Bluewater Network and the National Park Service. The action alternatives address continued PWC use under a special regulation for new management strategies and mitigation measures. The no-action alternative would discontinue PWC use after November 6, 2002.

Table 3 at the end of this chapter summarizes the alternatives being considered, and Table 4 summarizes the impacts of each alternative.

ALTERNATIVE A — CONTINUE PWC USE UNDER A SPECIAL REGULATION (PREFERRED ALTERNATIVE)

PWC use would be continued under a special regulation and would be managed consistent with the management strategies in effect before November 6, 2002. PWC users could travel wherever motorized vessels are authorized under the present "Superintendent's Compendium," which closes Hidden Cave Cove, Painted Canyon, and the water extending 300 feet from Amistad Dam to all public use. In addition, the "Superintendent's Compendium" prohibits all visitors, including PWC users, from landing in areas with interior least tern nesting colonies. Terns nest on islands and peninsulas on the lake from May 1 through August 31. To avoid disturbing nesting activity, these areas are closed to all public use during the nesting season, and signs are posted to warn visitors not to approach (see appendix A, which contains pertinent sections of the compendium).

All state and federal watercraft laws and regulations would continue to be enforced, including regulations that address reckless or negligent operation, excessive speed, hazardous wakes or washes, hours of operation, age of driver, and distance between vessels. The Texas Parks and Wildlife Code relating to PWC use is summarized below (Texas 2002):

1. Each occupant must wear a U.S. Coast Guard approved personal flotation device.
2. The cutoff switch (if provided) must be attached to the operator.
3. No PWC operation allowed between sunset and sunrise.
4. No PWC operations within 50 feet of any other vessel, person, stationary platform or other object, or shore, except at headway speed without creating a swell or wake.
5. Operator must be 16 years of age, or be accompanied by a person at least 18 years of age; or must be at least 13 years of age and have successfully completed a boating safety course prescribed and approved by the state.
6. No PWC operation within any area where motorboat use is prohibited by state law or local rule or regulation.
7. No towing water skis, an aquaplane, a surfboard, a tube, or any other similar device, unless the craft is designed to carry a minimum of two persons.

8. No jumping the wake of another vessel recklessly or coming unnecessarily close to that vessel.
9. No operation in a manner that requires the operator to swerve at the last possible moment to avoid a collision.

Who is allowed to rent a personal watercraft would not be restricted, other than the age restrictions defined by the state of Texas; enforcement procedures at Amistad would not be changed. The International Boundary Water Commission (IBWC) has a water quality monitoring program in effect, and its Texas Clean Rivers program includes four monitors within Amistad National Recreation Area (IBWC 2002a). The park would continue to comply with state minimum requirements. No additional monitoring or sampling would occur.

As required by law, all cultural resources would be protected through project-by-project inventories, and mitigating measures would be taken to reduce adverse effects related to use.

ALTERNATIVE B — CONTINUE PWC USE UNDER A SPECIAL REGULATION WITH MANAGEMENT RESTRICTIONS

To help protect cultural resources and enhance visitor experience, PWC use would continue under a special regulation that would further restrict use, in addition to the restrictions under alternative A as currently contained in the "Superintendent's Compendium":

- The Pecos River would be closed entirely to PWC use.
- Personal watercraft would be prohibited on the Rio Grande north of buoy 28.
- Personal watercraft would be prohibited on the Devils River north of buoy P, approximately 4–5 miles south of Indian Springs.
- Personal watercraft would be prohibited east of the San Pedro SPC-1 buoy, which would close all of San Pedro Canyon to PWC use.
- Two boat ramps in San Pedro Canyon would be closed to PWC use (the 277 north and south ramps).
- The Pecos River boat ramp would be closed to PWC use.
- PWC users would be prohibited from landing on islands with least tern nesting colonies, as defined in the "Superintendent's Compendium" (same as alternative A). These colonies occur on islands and peninsulas on the lake from May 1 through August 31. To avoid disturbing nesting activity, these areas are closed to all public use during the nesting season.

All state and federal laws and regulations would continue to be enforced, as described in alternative A.

Concessioners within the recreation area would comply with the following regulations:

- No one under the age of 21 could rent personal watercraft.
- PWC users ages 16 to 20 must operate within eyesight of an adult (21 and older).
- PWC operators under 16 must have an adult on board.
- Concessioners must carry liability insurance of $1 million.
- Concessioners must administer boat safety instruction to all PWC renters who do not have a boater safety certification; all renters would be required to view the video and sign a statement indicating that they will follow the printed safety instructions.

Park staff would improve and enhance enforcement under alternative B in order to reduce accidents and user conflicts by increasing boat patrols, monitoring areas by land, and increasing the number of rangers working in the park.

The International Boundary and Water Commission, United States and Mexico, has a water quality monitoring program in effect, and its Texas Clean Rivers program includes four segments within Amistad National Recreation Area and four monitoring stations within the Amistad Reservoir (Segment 2305) (IBWC 2002a). (Water quality data available from the four segments are discussed in the "Affected Environment" chapter.) No additional monitoring or sampling would occur. Improved and enhanced materials to educate visitors on PWC regulations and safe operating procedures would be available. These materials could be posted on park bulletin boards, handed out to PWC users at marinas, and posted on the park Web site (perhaps as a PWC-specific link).

NO-ACTION ALTERNATIVE — NO PWC USE

PWC use at Amistad National Recreation Area would be prohibited, and the National Park Service would not take action to draft a special regulation to continue PWC use after November 6, 2002.

ALTERNATIVES CONSIDERED BUT DISMISSED

One alternative discussed with park staff included prohibiting PWC users from entering a 100-foot buffer zone around the entire lake shoreline in order to protect cultural resources. However, it was decided that PWC users would require at least some landing areas (other than ramps and marinas), so the team discussed implementing a 100-foot shoreline buffer only in specific areas. After much discussion, the team realized that implementing such zones would be too difficult to enforce, so it was decided to restrict access by buoy markers. Buoys are easier for boaters to see (as opposed to shoreline delineations, such as signs), and buoys are also already in place. In addition, the no-wake zones imposed by existing Texas state regulations would help protect cultural sites and other visitors, such as kayakers, from wave action.

THE ENVIRONMENTALLY PREFERRED ALTERNATIVE

The environmentally preferred alternative is defined by the Council on Environmental Quality as the alternative that best meets the following criteria or objectives, as set out in section 101 of the National Environmental Policy Act:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
- Ensure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings.
- Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.
- Preserve important historic, cultural, and natural aspects of our national heritage and maintain, whenever possible, an environment that supports diversity and variety of individual choice.
- Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities.

- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

This discussion also summarizes the extent to which each alternative meets section 102(1) of the National Environmental Policy Act, which asks that agencies administer their own plans, regulations, and laws so that they are consistent with the policies outlined above to the fullest extent possible.

Alternative A would meet the six requirements detailed above. Because Amistad National Recreation Area was primarily created to "provide for public outdoor recreation use and enjoyment on the lands and waters associated with Lake Amistad," alternative A would also best satisfy the third requirement, which calls for attaining "the widest range of beneficial uses of the environment." Amistad's purpose is to "provide visitors and neighbors with opportunities and resources for safe, high-quality public outdoor recreation and use of Lake Amistad." The park is also significant in that it "offers diverse water-based recreational opportunities."

Alternative A would provide these recreational opportunities and beneficial uses "without degradation, risk of health or safety, or other undesirable or unintended consequences." Water quality impacts would be negligible adverse under both alternatives A and B. The same is true for air quality impacts. In addition, continued PWC use would not appreciably limit the critical characteristics of visitor experiences. Very few conflicts between PWC users and other visitors have been recorded at the park.

Alternative A would also provide for the safety of visitors by enforcing the provisions of the Texas Parks and Wildlife Code relating to PWC use, supporting diversity and variety of individual choice, and permitting high standards of living and a wide sharing of life's amenities.

Alternative B would have impacts on the national recreation area's natural resources similar to those under alternative A. Alternative B would better meet park goals with respect to the protection of cultural resources by prohibiting PWC use within certain areas of the reservoir. However, under alternative A, park enforcement and protection of cultural resources would adequately meet this objective.

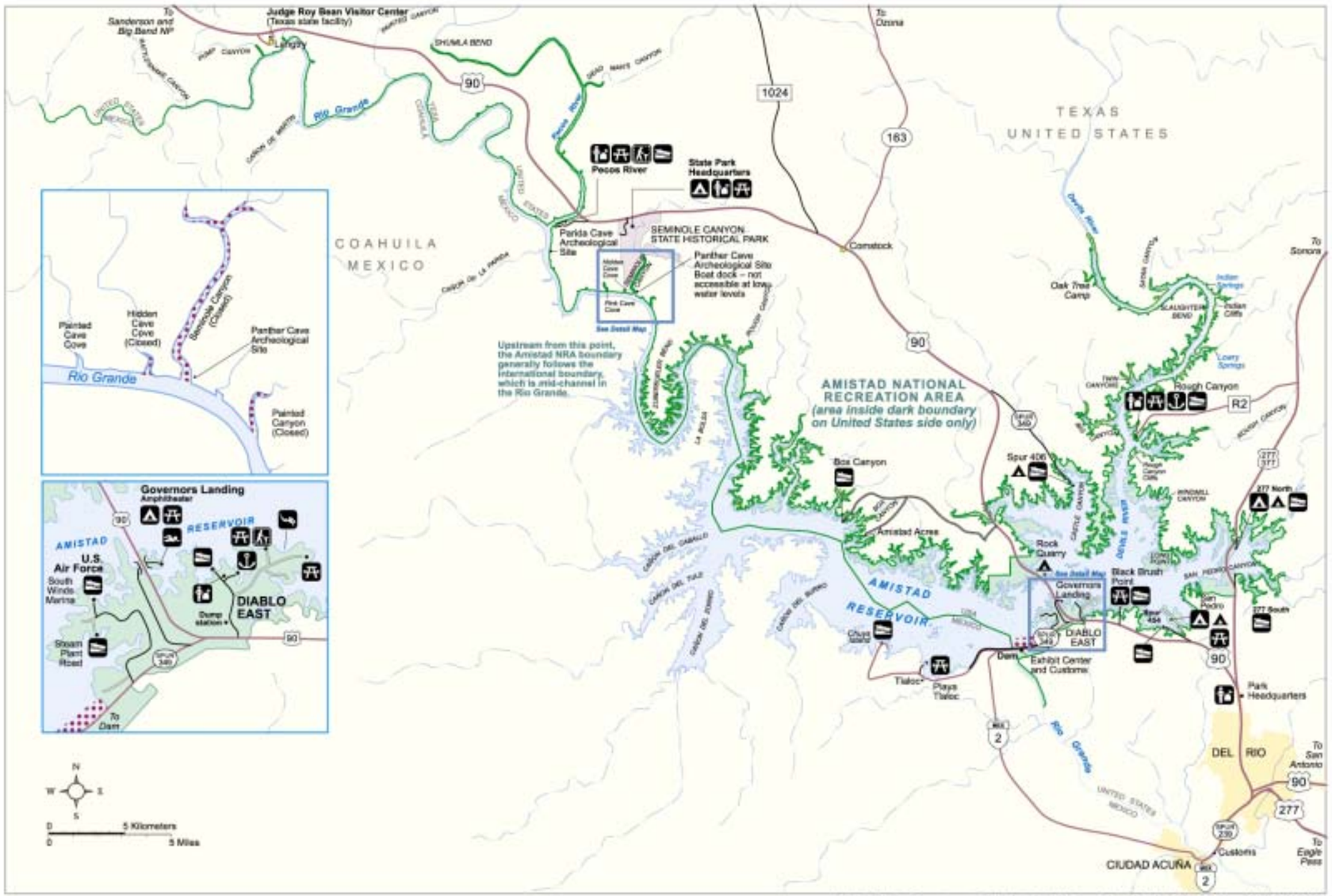
The no-action alternative would ensure a safe, healthful, productive, and aesthetically and culturally pleasing area for visitors to access without the threat of PWC users introducing noise and safety concerns. The no-action alternative would attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences by removing the PWC use from the national recreation area entirely. However, the no-action alternative would not fully meet the park's purpose of providing all visitors access to recreational opportunities on Lake Amistad. Therefore, the no action alternative would not maintain an environment that supports diversity and variety of individual choice, nor would it achieve a balance between population and resource use that permits a wide sharing of amenities.

Based on the analysis prepared for PWC use at Amistad National Recreation Area, alternative A is considered the environmentally preferred alternative by best fulfilling park responsibilities as trustee of sensitive habitat; by ensuring safe, healthful, productive, and aesthetically and culturally pleasing surroundings; and by attaining a wider range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences. Alternative A is also the NPS preferred alternative.

Amistad National Recreation Area

Texas

Alternative A -- Continue PWC Use under a Special Regulation



United States Department of the Interior / National Park Service WASO / Nov. '02 / 621/20037

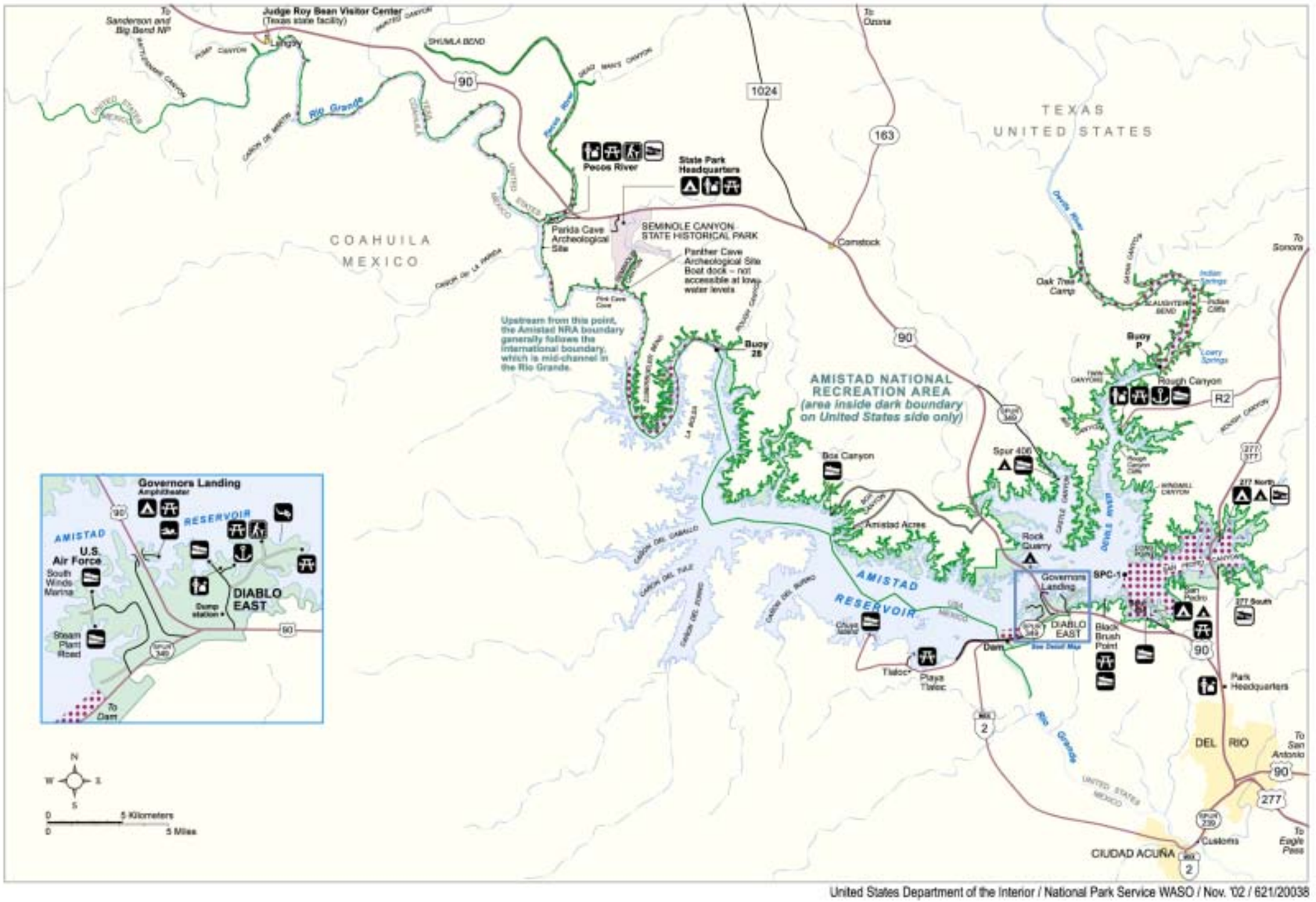
- Campground
- Group campground
- Ranger station
- Picnic area
- Nature trail
- Marina
- Boat launch
- Swimming area (unsupervised)
- Scuba diving
- PWC use prohibited

blank back of map

Amistad National Recreation Area

Texas

Alternative B -- Continue PWC Use under a Special Regulation with Management Restrictions



United States Department of the Interior / National Park Service WASO / Nov. '02 / 621/20038

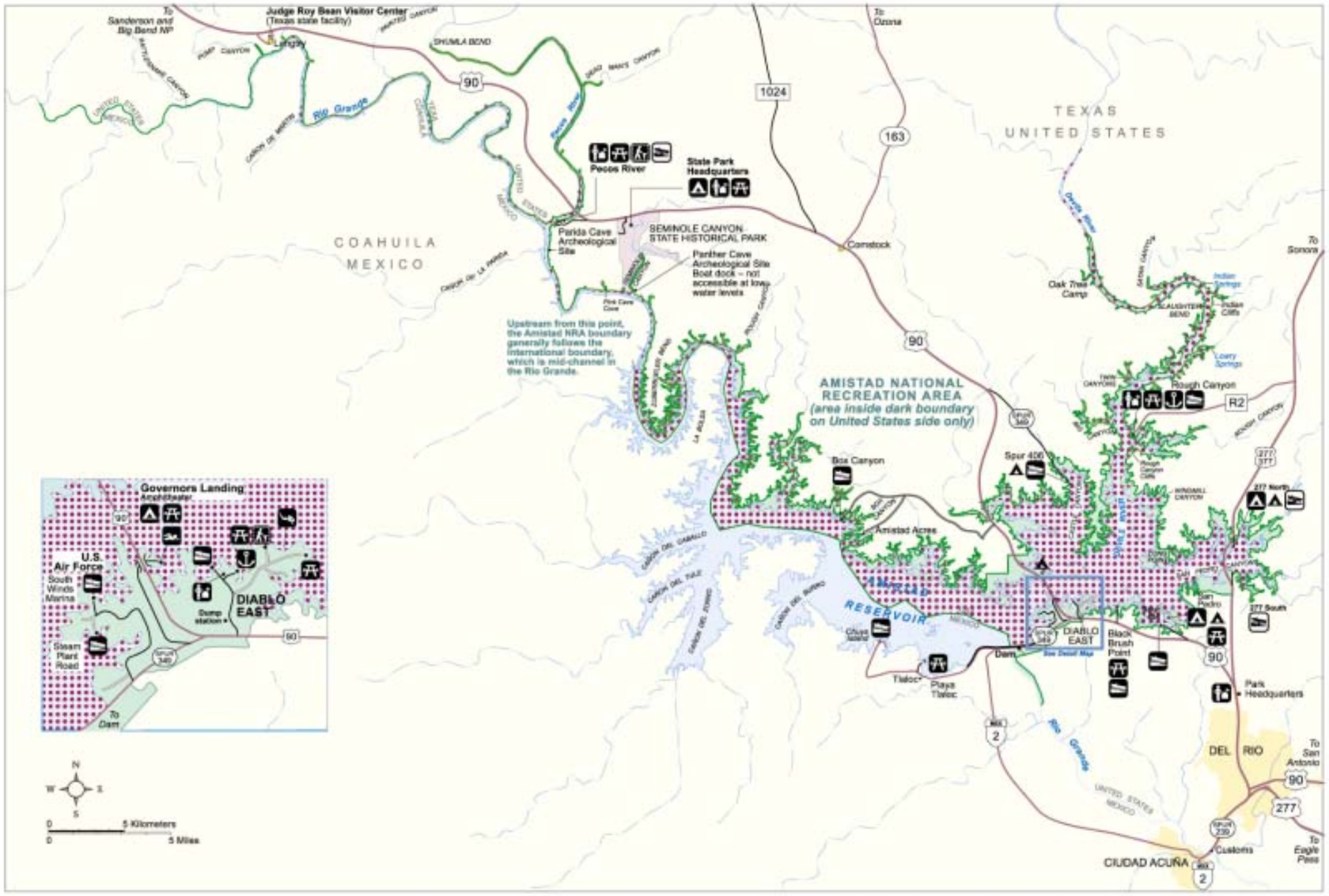
- Campground
- Group campground
- Ranger station
- Picnic area
- Nature trail
- Marina
- Boat launch
- Swimming area (unsupervised)
- Scuba diving
- PWC use prohibited
- Boat launch closed to PWC use

blank back of map

Amistad National Recreation Area

Texas

No-Action Alternative --
No PWC Use



United States Department of the Interior / National Park Service WASO / Nov. '02 / 621/20039

- Campground
- Group campground
- Ranger station
- Picnic area
- Nature trail
- Marina
- Boat launch
- Swimming area (unsupervised)
- Scuba diving
- PWC use prohibited
- Boat launch closed to PWC use

blank back of map

TABLE 3: SUMMARY OF ALTERNATIVES

	Alternative A — Continue PWC Use under a Special NPS Regulation	Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative — No PWC Use
PWC Management	Allow PWC use under a special regulation.	Allow PWC use under a special regulation.	Discontinue PWC use after November 6, 2002.
Use Area	Continue to restrict public access from those areas defined in the "Superintendent's Compendium": Hidden Cave Cove, Painted Canyon, Seminole Canyon, interior least tern nesting colony sites, and the water extending 300 feet from Amistad Dam. (Interior least tern colonies occur on islands and peninsulas on the lake from May 1 through August 31. These areas are closed to all public use during the nesting season.)	Same as alternative A, with the following additional restrictions: • Close the Pecos River entirely. • Close Rio Grande north of buoy 28. • Close Devils River north of buoy P. • Close San Pedro Canyon east of buoy SPC-1. • Close two boat ramps in San Pedro Canyon. • Close boat ramp at Pecos River.	Close all areas within the national recreation area to PWC use.
Engine Type	No restrictions.	No restrictions.	Not applicable.
Use Hours	Between sunrise and sunset.	Between sunrise and sunset.	Not applicable.
PWC Numbers	No limits.	No limits.	Not applicable.
PWC User Education	None.	Improved and enhanced materials to educate visitors on PWC regulations and safe operating procedures.	Not applicable.
State Regulations	1. Each occupant must wear a U.S. Coast Guard approved personal flotation device. 2. The cutoff switch (if provided) must be attached to the operator. 3. No PWC operation between sunset and sunrise. 4. No PWC operations within 50 feet of any other vessel, person, stationary platform or other object, or shore, except at headway speed. 5. Operator must be 16 years of age, or be accompanied by a person at least 18 years of age; or must be at least 13 years of age and have successfully completed a boating safety course prescribed and approved by the state. 6. No PWC operation within any area where motorboat use is prohibited by state law or local rule or regulation. 7. No towing water skis, an aquaplane, a surfboard, a tube, or any other similar device, unless the craft is designed to carry a minimum of two persons. 8. No jumping the wake of another vessel recklessly or coming unnecessarily close to that vessel.	Same as alternative A.	Not applicable.

	Alternative A — Continue PWC Use under a Special NPS Regulation	Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative — No PWC Use
	9. No operation in a manner that requires the operator to swerve at the last possible moment to avoid a collision.		
Concessioners	No restrictions (other than age restrictions defined by Texas) regarding who is allowed to rent PWC.	No one under the age of 21 could rent PWC. • PWC users between ages of 16 and 20 must operate within eyesight of an adult (21 and older). • PWC operators under 16 must have an adult on board. • Concessioners must carry liability insurance of $1 million. • Concessioners must administer boat safety instruction to all PWC renters who do not have a boater safety certification; all renters would be required to view the video and sign a statement indicating that they will follow the printed safety instructions.	No PWC use within the national recreation area.

TABLE 4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A — Continue PWC Use under a Special NPS Regulation	Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative — No PWC Use
Water Quality	Negligible adverse impacts. All pollutant loads would be well below ecotoxicological benchmarks and human health criteria. Cumulative impacts from PWC and motorized boat use would be negligible. By 2012, any impacts would be reduced substantially as a result of improved emission controls. No impairment of the water quality resource.	Negligible adverse impacts based on ecotoxicological and human health benchmarks in the reservoir and Rio Grande (area 1). Beneficial impacts in the Devils River and San Pedro Canyon (area 2) because PWC use would be prohibited. Cumulative impacts from PWC and motorboat use would be negligible. By 2012 all impacts would be reduced substantially through improved emission controls. No impairment of the water quality resource.	Beneficial impacts as a result of eliminating PWC use within the national recreation area. Emissions from other motorized watercraft would continue, with negligible adverse impacts. No impairment of the water resource.
Air Quality			
• Impacts to Human Health from Airborne Pollutants Related to PWC Use	Negligible adverse impacts for all pollutants. Cumulative emission levels would be negligible for PM_{10}, HC, VOC, and NO_x. PWC emissions are a small part of cumulative boating total HC emissions. Cumulative CO emissions would be moderate adverse for the short and long term. Over the long term NO_x emissions would increase slightly, with a negligible adverse effect. No alteration to existing air quality conditions, with future reductions anticipated in PM_{10}, HC, and VOC emissions due to improved emission controls. No impairment of air quality.	Negligible adverse impacts for all pollutants from PWC emissions. Cumulative emission levels from all boats and personal watercraft would be negligible for PM_{10}, HC, VOC, and NO_x, and moderate for CO in the short and long term. Over the long term NO_x emissions would increase slightly, with a negligible adverse effect. Existing air quality conditions would be maintained, with future reductions in PM_{10}, HC, and VOC emissions. No impairment of air quality.	Beneficial impacts resulting from discontinuing PWC use. PWC contribution to cumulative air quality impacts would be eliminated with associated reduction in emissions. Use by other boats is anticipated to increase by approximately 2% per year. Impact levels would not be altered and would remain moderate for CO and negligible for other pollutants for 2002 and 2012. With improved emission controls, future emission rates of most pollutants would gradually decline. No impairment of air quality.

Impact Topic	Alternative A — Continue PWC Use under a Special NPS Regulation	Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative — No PWC Use
• Impacts to Air Quality Related Values from Pollutants Related to PWC Use	Negligible impacts for ozone exposure for 2002 and 2012. No adverse effects to plants from ozone exposure. Negligible impact levels to visibility as $PM_{2.5}$ emissions would be below 50 tons/year for 2002 and 2012. Currently no perceptible qualitative visibility impacts; PWC impact levels on visibility would be negligible. Cumulative impacts from all boating activities would result in negligible impacts to air quality related values. No impairment of air quality related values.	Negligible adverse impacts to air quality related values in 2002 and 2012. Cumulative impacts from PWC and other marine boating activities would result in negligible adverse impacts to air quality related values for 2002 and 2012. No impairment of air quality related values.	Beneficial impacts from discontinuing PWC use. Ozone impacts from airborne pollutants related to all other boating activities would be negligible. Visibility impacts would be negligible, and overall impacts to air quality related values would be negligible. No impairment of air quality related values.
Soundscapes	Impacts would be short term, minor, and adverse at most locations throughout the use season. Impacts would be minor to moderate and adverse along the reservoir shoreline and at shoreline camping locations. Impact levels would be related to the number of PWC users and the sensitivity of other visitors. Over long term newer engine technologies could result in reduced noise levels. Cumulative noise impacts from PWC and motorboat use, as well as other visitors, would be short term and minor to moderate. Natural sounds would predominate at most locations. The highest sound impacts would occur near boat launches, beaches, and marinas. No impairment of the soundscape.	Impacts would be short term, minor, and adverse at most locations throughout the use season. Impacts would be short term, minor to moderate, and adverse along the reservoir shoreline. Impact levels would be related to the number of PWC users and the sensitivity of other visitors. Eliminating PWC use in specific segments would have beneficial impacts. Over long term newer engine technologies could result in reduced noise levels. Cumulative noise impacts from PWC and motorboat use, as well as other visitors, would be minor. Natural sounds would predominate at most locations. The highest sound increase impacts would occur near Diablo East and Spur 454; the highest decreases would occur along the Devils River and in San Pedro Canyon. No impairment of the soundscape.	The overall decrease in noise generated by personal watercraft would be a beneficial impact. Cumulative noise impacts from motorboats and other visitor activities would be short term, minor, and adverse, particularly near the Diablo East boat launch, but there would be no contribution to noise from PWC use. No impairment of the soundscape.
Wildlife and Wildlife Habitat	Impacts would be negligible at most locations. Effects from PWC speed and noise or proximity to wildlife would be limited because PWC users must operate at no-wake speeds within 50 feet of shore. Few wildlife are on open water, where speeds are higher. Cumulative impacts would have negligible to minor adverse effects on wildlife and wildlife habitat. All wildlife impacts would be temporary and short term. No impairment to wildlife or wildlife habitat.	Negligible reduction in overall impacts from restricting PWC use. Negligible impacts at most locations. Effects from PWC speed and noise or proximity to wildlife would be limited because PWC users must operate at no-wake speeds within 50 feet of the shore. Few wildlife are on the open water, where PWC speeds are higher. Cumulative impacts would have negligible to minor adverse effects on wildlife and wildlife habitat. All wildlife impacts would be temporary and short term. No impairment to wildlife or wildlife habitat.	Impacts to wildlife and habitat from PWC use would be eliminated, resulting in a beneficial impact. Cumulative impacts from other visitor uses would have negligible or no adverse impacts to fish, and negligible to minor impacts to waterfowl and other wildlife, with no perceptible changes in wildlife populations or their habitat community structure. No impairment of wildlife or wildlife habitat.
Threatened or Endangered Species or Species of Special Concern	This alternative would have no effect or would not likely adversely affect any federal or state listed species, since the identified species are either not present as permanent residents, do not have preferred habitat in areas used by PWC, or are not normally accessible. Cumulative effects from all park visitor activities would also not likely	This alternative would have no effect or would not likely adversely affect any federal or state listed species, since the identified species are either not present as permanent residents, do not have preferred habitat in areas open to PWC use, or are not normally accessible. Restricting PWC use in the more upstream areas of the rivers and limiting their	This alternative would have no effect on federal or state listed species. Cumulatively, the activities of other visitors and other boaters would not likely adversely affect federal or state listed animals and plants because the species are not present or are not accessible during normal visitor

Impact Topic	Alternative A — Continue PWC Use under a Special NPS Regulation	Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative — No PWC Use
	adversely affect these species since the species are not present, do not nest in the park, or are not accessible during normal visitor activities (primarily water-based recreation). No impairment of threatened, endangered, or special concern animal or plant species.	access in these areas would reduce the chances of adverse impacts to those species that utilize these areas, and increase the minor disturbance to the few species using open water. Cumulative effects from all park visitor activities would not likely adversely affect these species, since the species are not present or are not accessible during normal visitor activities (primarily includes water-based recreation). No impairment of threatened, endangered, or special concern species.	activities. PWC contribution to overall cumulative impacts to federal or state listed animal and plant species would be eliminated. No impairment of threatened, endangered, or special concern species.
Shoreline Vegetation	Negligible adverse impacts over the short and long term; no perceptible changes to plant community size, integrity or continuity, now or in the future (2012). Cumulatively, other impact sources are more prevalent than personal watercraft use. There are no obvious impacts now, and none are expected in the future, so impacts to shoreline vegetation would be negligible. No perceptible changes are expected to plant community size, integrity, or continuity now or by 2012. No impairment of shoreline vegetation.	Negligible adverse impacts over the short and long term because there are no perceptible changes to plant community size, integrity or continuity now, and none are expected in the future (2012). PWC restrictions would result in beneficial impacts to shoreline vegetation in closed areas. Cumulatively, other sources of impacts are more prevalent than PWC use. There are no obvious impacts now, and none are expected in the future, so impacts to shoreline vegetation would be negligible. No perceptible changes are expected to plant community size, integrity, or continuity now or by 2012. No impairment of shoreline vegetation.	Impacts would be beneficial as a result of stopping PWC use. No perceptible changes to plant community size, integrity, or continuity are expected now or by 2012. Cumulative impacts from other visitor uses would continue, but are expected to be negligible in the short and long term. PWC contribution to overall vegetation impacts would be eliminated. No perceptible changes are expected to plant community size, integrity, or continuity, now or by 2012. No impairment of shoreline vegetation.
Visitor Experience	Negligible adverse impacts for most visitors. Long-term, negligible, adverse impacts on shoreline campers, but long-term, minor adverse impacts on swimmers and other visitors using designated campgrounds. Cumulative effects would result in long-term, negligible to minor adverse impacts.	Negligible adverse impacts for most visitors. PWC restrictions at San Pedro Canyon and upper Devils River would have beneficial impacts on swimmers and visitors desiring natural “quiet.” The level of PWC use would remain approximately the same, but would be redistributed throughout the reservoir. Cumulative effects would result in long-term, negligible, adverse impacts.	Beneficial impacts for most visitors. Impacts on PWC users would be long term, moderate, and adverse. Beneficial cumulative impacts. Negligible adverse effect to other Texas waterbodies as a result of PWC users going to other locations.
Visitor Conflicts and Safety	Short- and long-term, minor to moderate, adverse impacts near Spur 454, Devils River upstream of Rough Canyon, and in front of the Diablo East harbor due to the number of visitors and boats present on high use days. Negligible conflicts at other locations because use is lower. Minor to moderate cumulative impacts for all user groups in the short and long term, particularly near the areas listed above. Negligible cumulative impacts in other segments.	Short- and long-term, minor, adverse impacts. Swimmers in the San Pedro Canyon area would experience beneficial impacts; other boaters would experience negligible adverse impacts due to increased congestion at popular boat launches and redistribution of PWC users. Negligible conflicts at other locations because use is lower. Conflicts would be eliminated in the Pecos River, resulting in beneficial impacts. Minor to moderate cumulative impacts for all user groups in the short and long term, particularly at Diablo East and San Pedro Canyon. Negligible cumulative impacts in other segments.	Beneficial impacts from reducing visitor conflicts and enhancing safety. PWC-related contributions to overall cumulative impacts to visitor safety would be eliminated. Visitor safety impacts from other sources would be negligible.

Impact Topic	Alternative A — Continue PWC Use under a Special NPS Regulation	Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative — No PWC Use
Cultural Resources (Archeological Sites, Submerged Cultural Resources)	Minor adverse impacts on archeological sites and submerged resources from possible illegal collection and vandalism by PWC users. Cumulative impacts on archeological and submerged cultural resources that are readily accessible could be minor to moderate adverse, due to the number of visitors and the potential for illegal collection or destruction. This alternative would not result in an impairment of cultural resources.	Minor adverse impacts on archeological sites and submerged resources from possible illegal collection and vandalism. Beneficial impact on resources in the Pecos River, Rio Grande north of buoy 28, Devils River north of buoy P, and San Pedro Canyon east of buoy SPC-1, where PWC use would be discontinued. Cumulative impacts of other activities on archeological and submerged cultural resources that are readily accessible could be minor to moderate adverse, due to the number of visitors and the potential for illegal collection or destruction. This alternative would not result in an impairment of cultural resources.	Minor beneficial impacts on archeological sites and submerged resources as a result of discontinuing PWC use. Cumulative impacts from all visitor activities would continue to be minor to moderate, depending on the accessibility of the resource and the potential for illegal collection or damage. This alternative would not result in an impairment of cultural resources.
Socioeconomic Effects	No change in PWC use anticipated, so no additional impact on the local or regional economy is expected.	Because Amistad would still be open to PWC with only minor restrictions in use areas, this alternative would result in negligible adverse impacts on PWC users. Given the level of PWC use, no measurable impacts on the local and regional economies are expected.	Visitors who use PWC exclusively would be adversely affected and might no longer make trips to the park. Some people using houseboats or powerboats as their primary form of water recreation who also ride personal watercraft might cancel their trips. Other visitors could still visit, but the value of their trip could be diminished by their inability to use PWC. Beneficial impacts on other visitors. Given the level of PWC use, no measurable impacts on the local and regional economies are expected.
National Recreation Area Management and Operations			
• Conflict with State and Local Regulations	NPS regulations for PWC use and boating would be the same as state regulations. Continued PWC use would not result in conflicts with state regulations. Impacts (including cumulative impacts) would be negligible.	No conflicts with state PWC regulations or policies. PWC and boating regulations would be similar to regulations currently in place for areas now closed to visitor use. Restrictions would apply only within the park's jurisdictional boundary. Impacts (including cumulative impacts) related to conflicts with national, federal, or state requirements or policies would be negligible.	Discontinuing PWC use within the national recreation area would not result in conflicts with state PWC regulations. Impacts (including cumulative impacts) related to such conflicts would be negligible.
• Impact to Park Operations from Increased Enforcement Needs	Negligible impacts because expected staff increases would be able to adequately enforce regulations related to PWC and other uses, even accounting for a projected increase in boat and PWC use. Cumulative impacts from all other activities would be minor.	Short-term, minor adverse impacts due to additional duties that would be required by NPS staff to implement and enforce the new PWC regulations and to educate visitors. Cumulative impacts would be minor.	Short-term, minor impacts from enforcement of the PWC ban. Beneficial impacts to park operations because staff would have additional time to focus on other activities. Cumulative impacts would continue to be minor, but PWC contribution to these impacts would be eliminated.

TABLE 5: ANALYSIS OF HOW ALTERNATIVES MEET OBJECTIVES

Issue	Objective	Alternative A — Continue PWC Use under a Special Regulation	Alternative B — Continue PWC Use under a Special Regulation and Implement Other Management Restrictions	No-Action Alternative — No PWC Use
Water Quality				
The majority of personal watercraft in use today are powered by conventional, two-stroke, carbureted engines, which discharge as much as 30% of their fuel directly into the water. Hydrocarbons, including benzene, toluene, ethylbenzene, and xylene (BTEX) and polyaromatic hydrocarbons (PAHs) are also released, as well as MTBE. These discharges have potential adverse effects on water quality.	Manage PWC emissions in accordance with antidegradation policies and goals.	Future EPA requirements will meet objective.	Same as alternative A.	Fully meets objective.
Some research shows that PWC emissions adversely affect water quality by increasing phototoxicity, which can damage ecologically sensitive plankton and other small water organisms. This in turn can affect aquatic life and ultimately aquatic food chains. The primary concern is in shallow water ecosystems.	Protect aquatic organisms from PWC emissions and sediment disturbances so that the viability of dependent species is conserved.	Future EPA requirements will meet objective.	Same as alternative A. Closing the Pecos River, Rio Grande north of buoy 28, and Devils River north of buoy P would restrict PWC from many shallow-water areas.	Fully meets objective.
Other water quality issues may include impacts on drinking water sources, indirect effects on threatened and endangered species sensitive to water quality changes and degradation; and effects on other fish.	Drinking water issue not applicable; remaining issues addressed in objective above.	Not applicable or addressed in other topics.	Same as alternative A.	Not applicable or addressed in other topics.
Air Quality				
Pollutant emissions, particularly nitrogen oxides and volatile organic compounds from personal watercraft, may adversely affect air quality. These compounds react with sunlight to form ozone. To the extent that nitrogen loading in the air contributes to the nutrient loading in the water column, PWC use adversely affects water quality.	Manage PWC activity so that air emissions of harmful compounds do not appreciably degrade ambient air quality.	Future EPA requirements will meet objective.	Same as alternative A.	Fully meets objective.
Soundscapes				
PWC-generated noise varies from vessel to vessel. Some literature states that all recently manufactured watercraft emit fewer than 80 dB at 50 feet from the vessel, while other sources attribute levels as high as 102 dB without specifying distance. None of this literature fully describes the method used to collect noise data. Noise measurements in 2001 at Glen Canyon National Recreation Area show that at 50 feet maximum PWC noise levels ranged from 68 to 76 dBA and for other motorboat types from 65 to 86 dBA. Noise limits established by the National Park Service are 82 dB at 82 feet. Personal watercraft may be more disturbing than other motorized vessels because of rapid changes in acceleration and direction of noise.	Manage noise from PWC use so that visitors' health, safety, and experiences are not adversely affected.	Meets objective but noise would continue to increase as PWC use increased.	Meets objective by closing areas with high concentrations of visitor use (San Pedro Canyon, north end of Devils River) to PWC.	Fully meets objective.

Issue	Objective	Alternative A — Continue PWC Use under a Special Regulation	Alternative B — Continue PWC Use under a Special Regulation and Implement Other Management Restrictions	No-Action Alternative — No PWC Use
Wildlife and Wildlife Habitat				
Some research suggests that personal watercraft have a greater impact on waterfowl and nesting birds because of their noise, speed, and ability to access shallow-water areas more readily than other types of watercraft. This may force nesting birds to abandon eggs during crucial embryo development stages and flush other waterfowl from habitat, causing stress and associated behavior changes.	Protect birds, waterfowl, and other wildlife from the effects of PWC-generated noise, especially during nesting seasons.	Meets objective. "Superintendent's Compendium" prohibits landing on all islands with federally endangered interior least tern nesting. Texas law prohibits PWC users from creating wakes within 50 feet of the shore.	Meets objective. Same as alternative A.	Fully meets objective.
Some research suggests that PWC use impacts wildlife by interrupting normal activities, causing alarm or flight, causing animals to avoid habitat, displacing habitat, and affecting reproductive success. This is thought to be caused by a combination of PWC speed, noise, and ability to access sensitive areas, especially in shallow-water areas. Literature suggests that personal watercraft can access sensitive shorelines, disrupting riparian habitat areas critical to wildlife.	Protect fish and wildlife species and their habitat from PWC disturbances. Protect fish and wildlife from the adverse effects that result from the bioaccumulation of contaminants emitted from personal watercraft.	Meets objective. Texas law prohibits PWC users from creating wakes within 50 feet of the shore.	Fully meets objective. Texas law prohibits PWC users from creating wakes within 50 feet of the shore. Closing the Pecos River, Rio Grande north of buoy 28, and Devils River north of buoy P would restrict PWC from many shallow-water areas.	Fully meets objective.
Threatened, Endangered, and Special Concern Species				
In some areas PWC use is believed to cause harm to threatened or endangered species because the machine's engine, submerged under the water, muffles the warning sounds some species depend on to escape from imminent danger.	Protect threatened or endangered species and their habitat from PWC disturbances.	Meets objective. "Superintendent's Compendium" prohibits landing on all islands with federally endangered interior least tern nesting.	Meets objective. Same as alternative A.	Fully meets objective.
Shoreline Vegetation				
PWC users are able to access areas where most other motorized watercraft users cannot go, which may disturb sensitive plant species. In addition, PWC users may land on the shoreline, allowing visitors to access areas where sensitive vegetation and plant species exist.	Manage PWC use to protect environmentally sensitive shoreline vegetation from PWC activity and access.	Meets objective. Amistad has very little shoreline vegetation due to fluctuating lake levels. Much existing shoreline vegetation consists of exotic species.	Fully meets objective. Amistad has very little shoreline vegetation due to fluctuating lake levels. Much existing shoreline vegetation consists of nonnative species. Closing the Pecos River, Rio Grande north of buoy 28, and Devils River north of buoy P would restrict areas where PWC users could land.	Fully meets objective.
Some research shows that personal watercraft create a wake at slower speeds than most larger boats, and when driven close to shore their wakes can lead to erosion and ultimately shoal formation.	Manage PWC use to protect environmentally sensitive shoreline areas from any potential erosion caused by PWC activity.	Meets objective. No shoal formation has been detected in the park. Natural causes contribute more to erosion that PWC wakes.	Fully meets objective. No shoal formation has been detected. Natural causes contribute more to erosion that PWC wakes. Closing the Pecos River, Rio Grande north of buoy 28, and Devils River north of buoy P would restrict areas where erosion from PWC wakes could occur. Cultural resources are concentrated in areas of restricted access.	Fully meets objective.

Issue	Objective	Alternative A — Continue PWC Use under a Special Regulation	Alternative B — Continue PWC Use under a Special Regulation and Implement Other Management Restrictions	No-Action Alternative — No PWC Use
Visitor Experience				
Some research suggests that personal watercraft are viewed by some segments of the public as a nuisance due to their noise, speed, and overall environmental effects. However, others believe that personal watercraft are no different from other motorcraft and that users have a right to enjoy the sport.	Manage potential conflicts between PWC users and other park visitors.	Meets objective. PWC users would continue to have access to the park as currently defined in the "Superintendent's Compendium."	Fully meets objective. Restricting PWC use from the Pecos River, Rio Grande north of buoy 28, and Devils River north of buoy P would provide other users park access without PWC. PWC users would still have access to the majority of park waters.	Does not meet objective.
Visitor Safety and Visitor Conflicts				
Personal watercraft make up 7.5% of the registered vessels in the United States, but are involved in 36% of all boating accidents. In part, this is believed to be a "boater education" issue, i.e., inexperienced riders lose control of the craft; yet it also is a function of PWC operation, i.e., no brakes or clutch. When drivers let up on the throttle to avoid a collision, steering becomes difficult.	Minimize or reduce the potential for PWC user accidents. Provide a safe and healthful environment for park visitors.	Meets objective. The number of tickets issued to PWC users in recent years has been declining. The park is expecting to increase the number of rangers working in the park.	Fully meets objective. The number of tickets issued to PWC users in recent years has been declining. Park staff would improve and enhance enforcement in order to reduce accidents and user conflicts by increasing boat patrols, monitoring areas by land, and increasing the number of rangers working in the park.	Fully meets objective.
Personal watercraft, due to their ability to reach speeds in the 60 mph range and their ability to access shallow-draft areas, can create wakes that pose a conflict and safety hazard to other users, such as canoeists and kayakers.	Minimize or reduce the potential safety conflicts between PWC users and other water recreationists.	Meets objective. If visitor and PWC use increased, the potential for conflict could increase.	Fully meets objective. Closing the Pecos River, Rio Grande north of buoy 28, and Devils River north of buoy P would restrict PWC use in areas that are popular with other visitors.	Fully meets objective.
Cultural Resources				
Cultural resources that are listed on, or potentially eligible for listing on, the National Register of Historic Places may be affected by erosion along shorelines, or uncontrolled visitor access since riders are able to access / beach / launch in areas less accessible to most motorcraft.	Manage PWC use and access to protect cultural resources.	Does not meet objective. PWC users would have access to areas where cultural resources are present.	Fully meets objective. Cultural resources are concentrated along the Pecos River, upper portions of the Rio Grande (beyond buoy 28), and near Indian Springs on the Devils River (north of buoy P). These areas would be closed to PWC use.	Fully meets objective.
Socioeconomic Environment				
National PWC ownership increased every year between 1991 and 1998; the rate of annual increase peaked in 1994 at 32% and dropped slightly in 1999 and 2000 (see Table 1). In 2001 there were 1,053,560 PWC, a 2.4% decrease from 2000 (National Marine Manufacturers Association 2002). PWC rentals have also increased exponentially, compared to other types of motorcraft. Some businesses may be affected by actions to increase or decrease PWC use.	Work cooperatively with concessioners and local businesses that rent or sell personal watercraft.	Fully meets objective. Only one local dealer sells personal watercraft and no local companies rent them.	Fully meets objective. Only one local dealer sells personal watercraft, and no local companies rent them.	Fully meets objective.

Issue	Objective	Alternative A — Continue PWC Use under a Special Regulation	Alternative B — Continue PWC Use under a Special Regulation and Implement Other Management Restrictions	No-Action Alternative — No PWC Use
National Recreation Area Management and Operations				
Personal watercraft, because of their increased accident rates and visitor safety conflicts, may require additional park staff to enforce standards and limits.	Provide a safe and healthful environment for park visitors.	Meets objective. The park is expecting to increase the number of rangers working in the park.	Fully meets objective. The park is expecting to increase the number of rangers working in the park. Visitor conflicts would be reduced in areas closed to PWC use (the Pecos River, Rio Grande north of buoy 28, and Devils River north of buoy P).	Fully meets objective.
PWC users are able to access shallow water areas where most other motorcraft cannot go, which may limit search-and-rescue limitations.	Minimize and reduce the potential for PWC access to areas that have limited ability for rescue capabilities.	Does not meet objective.	Meets objective by restricting PWC access from the Pecos River, Rio Grande north of buoy 28, and Devils River north of buoy P.	Fully meets objective.
Some states and local governments have taken action, or are considering taking action, to limit, ban, or otherwise manage PWC use. While the park may be exempt from these local actions, consistency with state and local plans must be evaluated.	Seek cooperation with local and state agencies that manage or regulate PWC use, as well as with international agencies.	Meets objective by applying state regulations. No PWC regulations on Mexico side of the reservoir.	Meets objective by applying state regulations. No PWC regulations on Mexico side of the reservoir.	Meets objective. No regulations on Mexico side of the reservoir.

THE AFFECTED ENVIRONMENT

Amistad National Recreation Area lies along the United States-Mexico border near Del Rio, Texas. The unit consists of 57,292 acres and is a man-made reservoir resulting from the construction of a 6-mile long dam on the Rio Grande. The reservoir is 1,117 feet above sea level at the normal conservation level, and the park boundary continues 83 miles northwest up the Rio Grande, 25 miles north up the Devils River, and 14 miles north up the Pecos River. The park boundary varies but is generally at the elevation mark of 1,144.3 feet above mean sea level, and lake levels fluctuate in relation to this.

WATER QUALITY

WATERSHED DESCRIPTION

The Rio Grande along the Texas-Mexico border stretches nearly 1,200 miles before reaching the Gulf of Mexico. Amistad National Recreation Area includes waters from the Rio Grande, Pecos River, and Devils River, plus a number of smaller tributaries to the Rio Grande. At conservation pool elevation (1,117 feet), the reservoir includes a total of 65,000 acres in the United States and Mexico plus 6 river miles of the Rio Grande, 3 river miles of the Pecos River, and 2.7 river miles of the Devils River. However, several years of below average rainfall have cause the pool elevation to fall considerably, and it is now 30 to 55 feet below the conservation pool level (NPS 2001a). The flow river miles of the tributary rivers have increased. At conservation pool elevation, approximately two thirds of the surface area of Amistad Reservoir is in the United States (43,250 acres), and one third is in Mexico (21,750 acres).

The Rio Grande portion of Amistad National Recreation Area stretches 36 miles upstream of the confluence with the Pecos River. Since the creation of the reservoir in 1969, the riparian zone along this section of the Rio Grande has become overgrown with a complex of willow, huisache *(Acacia famesiana),* river cane, and the nonnative salt cedar *(Tamarix* sp.) (NPS 2001b).

The Pecos River joins the Rio Grande in the upper portion of the recreation area and 14 miles of the river are included within the national recreation area boundary. Since 1995, the river has been free-flowing for approximately 9 miles from the park boundary to the reservoir pool. The Pecos River drains a watershed of 44,000 square miles. The upper portion of the watershed has long been used for irrigation. Much of the river channel is lined with salt cedar (NPS 2001a).

The Devils River enters the north side of the reservoir in the lower portion. Since 1995 the Devils River has been free-flowing for approximately 7 miles within the Amistad National Recreation Area boundary, prior to reaching the reservoir pool. Devils River drains a watershed area of 4,300 square miles. The river is spring-fed, its flow is not regulated, and it is largely uninfluenced by land use in the watershed. As a result, water quality of the Devils River is higher than in the Rio Grande or Pecos River. Native riparian vegetation has not been replaced by exotic species such as salt cedar (NPS 2001a).

WATER FLOWS

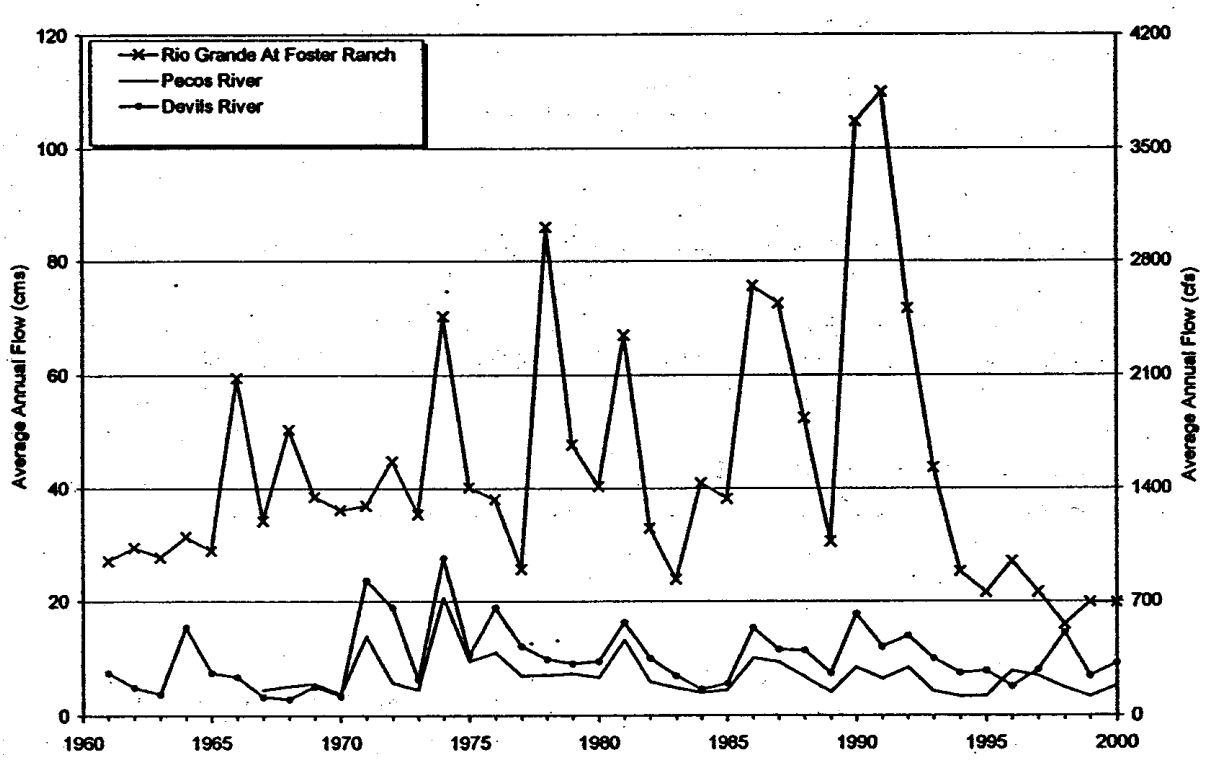
The Rio Grande, Pecos River, and Devils River contribute over 70% of the flow into Amistad Reservoir. The majority of the remaining inflows are from springs that flow directly into the Rio Grande and are either upstream of the reservoir or are now inundated in the reservoir (e.g.,

Goodenough Spring). Additional springs along Devils River (Willow and Indian Springs) also contribute to reservoir inflows.

The Rio Grande provides the majority of flow to the reservoir, but flows have markedly declined since the early 1990s. Flows are now the lowest since the dam was constructed in 1969 (average annual flows of approximately 700 cubic feet per second [cfs]). Until 1993 the majority of Rio Grande flow into the reservoir was from the Rio Conchos, which flows from the Sierra Madres in Mexico. However, decreased rainfall and increased water use in the Rio Conchos watershed have resulted in decreased flow into the Rio Grande and the reservoir.

Average annual flows in the Devils River are slightly higher than in the Pecos River, but both rivers have flows in the range of near 100 cfs to over 900 cfs. Base flows in the Pecos and Devils Rivers are 70 to 180 cfs and 110 to 250 cfs, respectively (NPS 2001a). Average annual flows in the three rivers (Rio Grande, Devils, and Pecos rivers) from 1960 through 2000 are shown in Figure 1.

FIGURE 1: AVERAGE ANNUAL FLOWS FOR THE RIO GRANDE, DEVILS RIVER, AND PECOS RIVER



Source: NPS 2001a.

RESERVOIR OPERATION

The Amistad Reservoir was designed to be used for water supply, flood control, hydroelectric generation, and recreation. At the conservation elevation of 1,117 feet, the reservoir holds 3,150,000 acre-feet of water (IBWC 2002b). However, since 1994 the elevation has been at least 32 feet lower than the conservation pool elevation (1,085 feet). On August 28, 2002, the reservoir elevation was reported by the IBWC to be 1,062 feet, and the volume was 849,000 acre-feet (IBWC 2002b). Of this total volume, 668,000 acre-feet were owned by the United States and 181,000 acre-feet by Mexico. The

Amistad Reservoir works in tandem with the Falcon Reservoir, located approximately 350 miles downstream of Amistad. Virtually all of the water released from the Amistad Reservoir goes to the Falcon Reservoir, where it is used for irrigation in the lower Rio Grande valley. At conservation elevation, approximately 85% of the water passing through these two reservoirs is used by agriculture.

Outflows from the reservoir change abruptly in response to storm events and irrigation demands downstream. In a typical year, the highest outflows (approximately 7,000 cfs) occur during the spring and early summer. Lower outflows (less than 1,500 cfs) typically are seen the remainder of the year, except in response to storm events.

TEXAS SURFACE WATER QUALITY STANDARDS

State-Designated Stream Segments and Uses

In accordance with EPA guidelines, the Texas Commission on Environmental Quality (TCEQ) (formerly the Texas Natural Resource Conservation Commission [TNRCC]) has classified major stream segments within the state according to designated uses. Potential uses within a segment include aquatic life, contact recreation, public water supply, and general uses, all of which are fully supported at Amistad. Segments are described in appendix C of the "Texas Surface Water Quality Standards" of the *Texas Administrative Code* (30 TAC 307) (TNRCC 2000). In order to support or achieve the designated uses of these stream segments, the commission has promulgated numerical criteria for each use and each segment. The "Water Quality Data" section below describes the water quality parameters compiled for standard pollutants at Amistad Reservoir.

The area of potential PWC use in Amistad National Recreation Area includes the Amistad Reservoir (segment 2305), the Rio Grande above the reservoir (segment 2306), Devils River (segment 2309), and lower Pecos River (segment 2310). As defined in appendix A of the "Texas Surface Water Quality Standards," two of the designated uses of all four segments are contact recreation and public water supply (TNRCC 2000). However, there are no drinking water intakes associated with Amistad National Recreation Area (NPS 1995b). The Amistad Reservoir, Rio Grande, and lower Pecos River also have "high aquatic life" as a designated use. The Devils River has "exceptional aquatic life" as a designated use (TNRCC 2000).

NUMERIC STANDARDS

The "Texas Surface Water Quality Standards" do not include aquatic life standards for typical gasoline organic constituents such as benzene or PAHs (TNRCC 2000). For freshwater, standards for benzene and benzo(a)pyrene, are shown in Table 6.

TABLE 6: TEXAS WATER QUALITY STANDARDS FOR BENZENE AND BENZO(A)PYRENE

Chemical	Ingestion of Water and Fish (μg/L)	Ingestion of Fish Only (μg/L)
Benzene	5	106
Benzo(a)pyrene	0.099	0.81

SOURCE: TNRCC 2000.

No segment-specific standards are provided for organic compounds associated with gasoline (sec. 307.10 TAC; TNRCC 2000).

Antidegradation Policy

The state-established antidegradation policy (sec. 307.5, "Texas Surface Water Quality Standards"; TNRCC 2000) is designed to protect water quality at existing levels and to prevent a deterioration of water quality below achievable uses for a given stream segment. The policy has three levels of protection:

1. Existing uses will be maintained and protected.
2. For instream segments whose quality exceeds designated uses, degradation may only be allowed for important social and economic development.
3. No degradation will be allowed for outstanding natural resource waters. No waters in the state are currently designated as an outstanding natural resource

For Amistad Reservoir and the primary rivers feeding into the reservoir (Rio Grande, Pecos River, and Devils River), antidegradation means that existing uses should be maintained and protected.

WATER QUALITY DATA

A large amount of water quality data have been collected for standard pollutants in the Amistad Reservoir and the principal drainages to the reservoir. A compilation of the data from six US EPA databases is presented in the "Baseline Water Quality Data Inventory and Analysis — Amistad National Recreation Area" (NPS 1995b). Water quality data were compiled from 84 monitoring stations for up to 30 years (depending on the monitoring station), from 1964 through 1993. The principal water quality parameters compiled and summarized include temperature, dissolved oxygen, pH, turbidity, coliform bacteria, chloride, nitrate, sulfate, metals, and selected pesticides/herbicides. Additional parameters such as conductance, transparency, alkalinity, and PCBs were measured at some monitoring stations. Data for the organic compounds used in the analysis of water impacts from PWC use (e.g., benzene, PAHs, MTBE) were not available in the US EPA databases consulted, and therefore, were not presented in the report (NPS 1995b).

Results of a water quality screen found 16 water quality parameters that exceeded a screening benchmark in at least one sample from one of the monitoring stations (NPS 1995b). Dissolved oxygen, pH, chloride, turbidity, cadmium, copper, lead, mercury, and zinc exceeded their benchmarks for the protection of freshwater aquatic life. Nitrate, chloride, sulfate, bacteria, barium beryllium, cadmium, chromium, lead, mercury, and nickel exceeded their benchmarks for drinking water or bathing.

A summary of basic water quality results includes data collected from 1993 through 1999 (NPS 2001a). The Texas Natural Resource Conservation Commission used water quality data collected from stations in the reservoir and contributing rivers to determine the impairment status of these waters, as defined by the Clean Water Act (40 CFR 130) and shown in Table 7. Under this act, an impaired waterbody is one where water quality standards are not attained or maintained.

A number of metals have been detected in surface water above the TCEQ screening levels. In the Rio Grande above Amistad Reservoir, antimony, arsenic, selenium, thallium, and zinc have been found above screening levels. In the reservoir, antimony, arsenic, cadmium, and lead have been found above screening levels. No metals were detected in surface water above screening levels in the Pecos River or in the Rio Grande downstream of the reservoir (TNRCC 1997).

Water quality trends in most of the waterbodies include increasing salinities and trace elements (NPS 2001a). In the Rio Grande salinity has been increasing over the past 30 years due to increased irriga-

TABLE 7: IMPAIRMENT STATUS OF AMISTAD RESERVOIR WATERS AS DEFINED BY THE CLEAN WATER ACT

Segment	Summary of Impairment (per TCEQ definitions)	Impairment Cause
2305 (Amistad Reservoir)	No impairment; nutrient (phosphorus) concern	
2306 (Rio Grande above reservoir)	Bacteria levels occasionally exceed criteria for contact recreation; ambient toxicity in water occasionally exceeds aquatic life criteria	Pathogens, ambient toxicity in water
2309 (Devils River)	No impairment	
2310 (Lower Pecos River)	No current impairment; formerly impaired due to average concentration of chloride, sulfate, and total dissolved solids exceeding criteria	

SOURCE: TNRCC 2000b.

tion return flows, municipal outfalls, and a higher percentage of flow from the Rio Grande upstream of the Rio Conchos (the Rio Grande has higher salt levels than the Rio Conchos). In the Pecos River average salinity is also increasing as flows in the river decrease. Concentrations of mercury are also increasing in the river. No water quality trends in the Devils River have been noted, but fewer data are available for this river than the other rivers investigated. In the reservoir in recent years, water levels are lower. Higher concentrations of chloride, sulfate, and total dissolved solids in the main body of the reservoir relative to concentrations in the Devils River arm of the reservoir are correlated with these lower reservoir water elevations. These differences are expected to increase due to increasing salinity levels in the Rio Grande (NPS 2001a).

OTHER CONTRIBUTIONS AFFECTING WATER QUALITY CONDITIONS

Boating activity within Amistad National Recreation Area includes tour boats, fishing and speedboats, and personal watercraft. All of these watercraft contribute pollutants of concern to the waters within the national recreation area. The quantity of pollutants contributed depends on the type and number of watercraft and the length of time they operate within the national recreation area.

Oil and gas exploratory work is occurring along the Pecos River. Three known wells have been established in the past 10 years near Dead Man's Canyon, a tributary to the Pecos River. Drilling is ongoing and appears to be a permanent operation (J. Labadie, NPS, pers. comm., P. Steinholtz, URS, Aug. 15, 2002).

AIR QUALITY

Amistad National Recreation Area is in a class II area for purposes of air quality. For purposes of air quality monitoring, it is in the Laredo Area (Region 16). Air quality in the region is generally good and it is in attainment with all national ambient air quality standards (NAAQS); it is not subject to a maintenance plan for any pollutant (see Table 8).

The nearest air monitoring site for criteria pollutants is in Laredo, approximately 150 miles southeast. Prevailing airflow during most of the year is from the southeast and the Gulf of Mexico, shifting to flow from the northwest during the winter. These seasonal flow patterns are important because they transport various air pollutants from industrial and urban areas into the unit. Air contaminants from Texas sources and possibly from coal-fired plants in Mexico (particularly in Nava, approximately 70 miles southeast of Amistad and south of Piedras Negras) could degrade air quality. Ciudad Acuña also has manufacturing plants, a tire testing facility, and a municipal dump, which may affect air quality

(D. Larson, NPS, pers. comm., P. Steinholtz, URS, Aug. 14, 2002). Big Bend National Park is the closest class I area and is approximately 140 miles west of Amistad. Fine particulate matter, which affects visibility, is monitored at Big Bend through the jointly operated Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring network. IMPROVE is a cooperative effort between the U.S. Environmental Protection Agency, the National Oceanic and Atmospheric Administration, the National Park Service, the U.S. Forest Service, the Bureau of Land Management, the U.S. Fish and Wildlife Service, and state governments.

The Texas Commission on Environmental Quality (TCEQ), formerly the Texas Natural Resource Conservation Commission, is the lead environmental agency for the state and is responsible for the State Implementation Plan to ensure compliance with the federal Clean Air Act (TNRCC 2002d).

TABLE 8: NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Primary Standards (Human Health)		Secondary Standards (Air Quality Related Values)	
	Average Type	Concentration[a]	Average Type	Concentration[a]
CO	8-hour[b]	9 ppm (10 mg/m^3)	No secondary standard	
	1-hour[b]	35 ppm (40 mg/m^3)	No secondary standard	
Pb	Maximum Quarterly Average[h]	1.5 µg/m^3	Same as primary standard	
NO_2	Annual Arithmetic Mean[h]	0.053 ppm (100 µg/m^3)	Same as primary standard	
O_3 (implementation of 8-hour standard not currently final)	1-hour[c]	0.12 ppm (235 µg/m^3)	Same as primary standard	
	8-hour[i]	0.08 ppm (157 µg/m^3)	Same as primary standard	
PM-10	Annual Arithmetic Mean[d]	50 µg/m^3	Same as primary standard	
	24-hour[e]	150 µg/m^3	Same as primary standard	
PM-2.5 (monitored but standards not currently final)	Annual Arithmetic Mean[d,f]	15 µg/m^3	Same as primary standard	
	24-hour[g]	65 µg/m^3	Same as primary standard	
SO_2	Annual Arithmetic Mean[h]	0.03 ppm (80 µg/m^3)	3-hour[b]	0.50 ppm
	24-hour[b]	0.14 ppm		(1300 µg/m^3)

a. Parenthetical value is an approximately equivalent concentration.
b. Not to be exceeded more than once per year.
c. Attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is equal to or less than 1, as determined according to Appendix H of the O_3 NAAQS.
d. Not to be exceeded by the 3-year average of the annual mean concentrations.
e. Not to be exceeded by the 3-year average of the annual 99th percentile concentrations.
f. May be spatially averaged over several "community-oriented" sites in an area.
g. Not to be exceeded by the 3-year average of the annual 98th percentile concentrations.
h. Never to be exceeded.
i. Not to be exceeded by the 4th highest annual value averaged over a 3 year period.

Air quality is monitored using a statewide air quality surveillance network. Data are collected from air monitoring sites, local agencies, and private monitoring networks. Generally, monitoring sites are near metropolitan areas since these areas have the highest pollutant levels; no monitoring sites are in or near Amistad National Recreation Area, and the nearest station is in Laredo (150 miles away), where ozone, carbon monoxide, and particulate matter are monitored (TNRCC 2002d). The most recent data available are for 2001.

As part of the ongoing efforts of the U.S.-Mexico Binational Air Workgroup, U.S. and Mexican agencies, Los Alamos National Laboratory, area state and local air pollution departments, and universities participated in the Paso del Norte Summer Ozone Study in July–September 1996. This was the first major, joint photochemical oxidants study attempted along the U.S.-Mexico border (US EPA 2002).

EPA Region 6 has continued to support transboundary studies of air transport. The Amistad unit may be subject to ozone and other pollutant impacts from transboundary migration, and this topic has been considered qualitatively in the assessment of cumulative impacts.

SOUNDSCAPES

NATURAL AND HUMAN NOISE LEVELS

Noise is defined as an unwanted sound. Sounds are described as noise if they interfere with an activity or disturb the person hearing them. Sound is measured in a logarithmic unit called a decibel (dB). Since the human ear is more sensitive to middle and high frequency sounds than to low frequency sounds, sound levels are weighted to reflect human perceptions more closely. These "A-weighted" sounds are measured using the decibel unit dBA. Table 9 illustrates common sounds and the measured sound level.

TABLE 9: SOUND LEVEL COMPARISON CHART

Decibels	How it Feels	Equivalent Sounds	Sound Levels in Amistad
140-160	Near permanent damage from short exposure	Large caliber rifles (e.g., .243, 30-06)	
130-140	Pain to ears	.22 caliber weapon	
100	Very loud	Air compressor at 20 feet; garbage trucks and city buses	
	Conversation stops	Power lawnmower; diesel truck at 25 feet	V-8 "muscle boat" (20-foot inboard V-8) at 50 feet.*
90	Intolerable for phone use	Steady flow of freeway traffic; 10 HP outboard motor; garbage disposal	
80		Muffled PWC at 50 feet; automatic dishwasher; near drilling rig; vacuum cleaner	18-foot boat with outboard motor.*
70		Drilling rig at 200 feet; window air conditioner outside at 2 feet	
60	Quiet	Window air conditioner in room; normal conversation	Watching PWC operating 160 feet from San Pedro Canyon shoreline. **
50	Sleep interference	Quiet home in evening	Paddling the Pecos River in a canoe.
		Bird calls	
40		Library	
30		Soft whisper	
20		In a quiet house at midnight; leaves rustling	

Note: Modified from *Final Environmental Impact Statement,* Miccosukee 3-1 Exploratory Well, Broward County, Florida (U.S. Department of the Interior).

* NPS 2002c.

** Based on Komanoff and Shaw 2000.

For the average human a 10 dB increase in the measured sound level is subjectively perceived as being twice as loud, and a 10 dB decrease is perceived as half as loud. The decibel change at which the average human would indicate that the sound is just perceptibly louder or perceptibly quieter is 3 dB.

RESPONSES TO PWC NOISE

Many factors affect how an individual responds to noise. Primary acoustical factors include the sound level, its frequency, and duration. Secondary acoustical factors include the spectral complexity, sound

level fluctuations, frequency fluctuation, rise-time of the noise, and localization of the noise source (Mestre Greve Associates 1992).

Non-acoustical factors also play a role in how an individual responds to sounds. These factors vary from the past experience and adaptability of an individual to the predictability of when a noise will occur. The listener's activity also affects how he/she responds to noise.

Personal watercraft generate noise that varies in pitch and frequency due to the nature of their construction and use. The two-stroke engines are often used at high speeds, and the craft bounce along the top of the water such that the motor discharges noise below and above the water surface. To visitors this irregular noise seems to be more annoying that that of a standard motorboat that is cruising along the shoreline, even though the maximum noise levels may be similar for the two watercraft. Additionally, visitors who expect to experience natural quiet may consider the irregular noise of personal watercraft more annoying, especially if the craft is operating in one location for extended periods of time (Komanoff and Shaw 2000).

NOISE LEVELS AT AMISTAD NATIONAL RECREATION AREA

Amistad National Recreation Area is relatively undeveloped, with few roads and visitor amenities. The most dominant natural sounds are the waves of Amistad Reservoir and wind. The most dominant human-made noises are from boats on the reservoir, especially powerboats, boats driving in circles, and an occasional U.S. Border Patrol airboat, which travels the Rio Grande to the Pecos River and Seminole Canyon. Airboats are potentially noisier than personal watercraft, although this has not been measured and documented. Amistad's "Superintendent's Compendium" allows vessels to travel anywhere except near the dam and swim beaches. The compendium also lists specific areas that are off-limits to motorized boat use, including Painted, Hidden, and Seminole Canyons. Smaller boats, such as bass boats, general fishing boats, and water-skiing boats usually have outboard motors in the range of 150 to 225 hp, with a few 65 hp and 90 hp outboard motors on older boats. Larger boats, generally cabin cruisers (28 to 35 feet) and speed boats with "dry-pipe" engines are either diesel or gasoline powered. The cabin cruisers are not very loud, but the speed boats are probably the loudest watercraft on the lake. Not many speed boats use Amistad, but their presence on the lake is always known (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 5, 2002). The Personal Watercraft Industry Association believes that through the year 2002, most PWC output is between 155 and 165 horsepower (PWIA, e-mail to National Park Service, Sept. 23, 2002).

Noise levels vary from the north to the south ends of the park. The northwest end is not as affected by PWC noise as the southeast end, where use is more heavily concentrated. The most common areas for PWC and other motorized watercraft use at Amistad National Recreation Area are in Diablo East, San Pedro Canyon, and Devils River (Garetz 2002a). Noise sources in these areas include powerboats, fishing vessels, personal watercraft, commercial vessels, small aircraft, automobiles, and firearms during hunting season.

The Diablo East area contains a concentration of activities that are non-natural noise sources, including three picnic areas, one marina, a dump station, one campground, three boat launches, a ranger station, and a short interpretive trail. Diablo East has the largest boat ramp and parking lot on the lake. The marina and boat launches at this location receive some of the highest boat use at the park and related noise levels can be high on busy days. This is the primary access point for bass tournament anglers during low lake levels. South Winds Marina, operated by the U.S. Air Force, is also located in this area. The majority of PWC operators using this launch are active military personnel from Laughlin Air Force Base, located 20 miles from the lake. PWC users launching from this ramp have

been observed traveling throughout the lake area (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Aug. 14, 2002).

The San Pedro area is adjacent to Diablo East, and visitors who launch there can easily access San Pedro Canyon. The San Pedro area contains four boat launches, two campgrounds, two group campgrounds, and two picnic areas. Spur 454, which is located in this area, is one of the park's busiest boat launches, and related noise levels can be high on busy days. The Spur 454 boat launch is closest to the Del Rio city limits, and is one of the few areas where visitors can drive close to the shoreline and watch friends and family members riding their PWC. This is where the largest concentration of PWC users are located. PWC users come in large extended family groups, and often have four to six personal watercraft in their group.

Rough Canyon on the Devils River contains one marina, one boat launch, one picnic area, and a ranger station. PWC users dock here to refill their gas tanks. Devils River is one of the most popular PWC destinations, and PWC users travel past the Devils Shores housing development en route to Indian Springs. This boat ramp stays open even during extremely low lake level conditions, and nonnatural noise levels can be relatively high at the marina area.

The Pecos River area (in the northwest end of the park) is quieter, with fewer personal or motorized watercraft generating noise in the area. The northern end of the park is shallower, and PWC users have difficulty accessing the low waters of the Pecos River. However, the number of houseboats towing personal watercraft appears to be increasing, and houseboats typically head for the northern section of the park (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 1, 2002).

The Box Canyon ramp is located on the Rio Grande at the end of an 8-mile dirt road, and is the only boat ramp access located on the upper section of the lake. PWC operators here appear to be visitors who own a house or trailer in the Box Canyon/Amistad Acres residential areas, or have friends who do. PWC operators who launch here have been observed operating on the Rio Grande near mid-channel buoy 12 (where the launch ramp is located) and in adjacent coves.

Automobile noise is very limited because most roads are south and east of the park; noise is relegated to the entrance roads that lead to boat launches, campgrounds, and picnic areas (see Location map). The town of Del Rio is far enough from the national recreation area as to not be a source of noise. No other communities or developments exist near the reservoir that could substantially contribute to the park's noise levels.

During weekdays there are long periods during the day with no watercraft noise. Anglers turn off their outboard motors once they arrive at a fishing spot and use their electric trolling motors while fishing. Anglers generate motorized noise only when they launch in the morning and return in the afternoon (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 5, 2002).

The only time there is continuous noise from boating activity is on busy summer weekends, usually Saturdays, when the park receives many sightseers and water-skiers who continuously drive back and forth. Bass fishing tournaments occur almost every weekend, which also increases visitation. However, even on busy Saturdays, there are many places in the Diablo East area where visitors can enjoy occasional periods of quiet and listen to the park's natural sounds (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 5, 2002).

Amistad National Recreation Area is not zoned for different visitor uses. The park allows for multiple use, but the focus is primarily on boat-based recreation. No primitive or natural areas have been established in the park, and border issues with Mexico also preclude defining primitive or natural

areas. For example, the park considered making the upper reaches of some rivers accessible only to canoes, but these areas must also be accessible to the Border Patrol, which uses airboats (D. Larson, NPS, pers. comm., P. Steinholtz, URS, Oct. 31, 2002).

Bass anglers have complained about PWC noise. Two housing developments are near the Box Canyon boat ramp, and a resident has complained about PWC noise. At low water the picnic and campground areas are farther above the water level, so there is less of a noise problem. When water was higher in 1993, PWC noise was a problem at the San Pedro campground. A housing development also exists on the Devils River, but the lake level is currently low, and park staff have received no complaints about noise. When water levels rise, there is more potential for complaints from campers and nearby residents. However, most visitors avoid camping in the hot summer months, which is when PWC use is highest (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Aug. 14, 2002).

WILDLIFE AND WILDLIFE HABITAT

Lake Amistad National Recreation Area is in a transition zone of three major biotic communities — Chihuahuan desert from the west, Edwards Plateau to the north, and Tamaulipan shrubland to the south and east. The climate is semiarid and continental, with dry winters and hot summers. Mean annual precipitation is 17.2 inches, falling primarily between April and October. The majority of soils are very shallow to shallow, moderately alkaline, stony loams underlain by caliche. Rock outcrops with no soil development comprise about 15%–35% of the area (Texas Parks and Wildlife Department [TPWD] 1995).

South Texas brushlands converge on the Chihuahuan Desert to the southwest and on the Tamaulipan chaparral country to the southeast. Most park lands are chaparral country — low hills and valleys near the dam, with canyons primarily upstream. Common plants are uniformly drylands-adapted: catclaw, ocotillo, yucca, ceniza, lechuguilla, sotol, and cactus. Trees are typically low-growing and include mesquite, Texas persimmon, huisache, hackberry, live oak, and Texas mountain laurel.

Lake Amistad's 1995 biological survey identified four plant communities as potentially occurring at the park, including one grassland (the Curlymesquite-Sideoats Grama series) and three shrublands (the Cenizo, Guajillo, and Blackbrush series). The grassland may have become extirpated due to over-grazing. Overgrazing and fires have encouraged the proliferation of woody, less palatable species that form the current plant community at Amistad (TPWD 1995).

Because of sparse vegetation and the lack of prime habitat, few mammals, amphibians, and reptiles are seen at Amistad, and none were recorded during the 1995 biological survey. However, several bird and fish species exist in the area, and hunting is permitted for deer, mouflon sheep, javelina, turkey, rabbits, and feral hogs. In addition, the "Superintendent's Compendium" permits hunting for dove, quail, teal, and ducks.

MAMMALS

Approximately 62 species of mammals occur in Val Verde County. However, no mammals were observed in Amistad National Recreation Area during a biological survey conducted one afternoon in May 1993; no further mammal surveys have been conducted since (TPWD 1995). Mammals that occur in Val Verde County have the potential to occur in the park, but few have been documented. Some bat specimens have been collected or observed within Amistad National Recreation Area, and some bat species are thought to occur but also have not been documented. Numerous limestone caves

that provide habitat for bats are found in a large area around and including Lake Amistad. Beaver occur in the park and are fairly common. Black bear are occasionally sighted near campgrounds; the last sighting was in 1994. All sightings were of black bears passing through the area (see "Threatened, Endangered, or Special Concern Species" below for additional information about bats and black bears).

BIRDS

Amistad is on the central flyway for migratory birds, and Amistad is habitat for both resident and migratory birds. The park has not documented any illegal issues related to the Migratory Bird Treaty Act. With the exception of the interior least tern, Amistad's migratory birds always nest high enough above ground to not be affected by wave action; therefore, they would not be affected by PWC-related wave action or shoreline access. Interior least terns lay eggs in the ground, and they have been impacted by inundation caused by the dam. The terns never nest close enough to the water for eggs to be damaged by wave action, and the park closes all tern nesting areas to public use by posting signs in the water (D. Larson, NPS, pers. comm., P. Steinholtz, URS, Oct. 31, 2002G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Aug. 22, 2002, re: least tern islands).

Forty-five species of birds exist at Amistad National Recreation Area, and over 300 bird species exist in Val Verde County. Common birds seen in Amistad include vultures, ravens, scaled quail, mourning and white-winged doves, hawks, herons, sandpipers, and occasionally eagles. Several federally listed species are known to occur (see "Threatened, Endangered, or Special Concern Species" below for additional information).

FISH

Amistad Reservoir is a popular fishing destination, and bass fishing tournaments are held nearly every weekend year-round. Anglers fish for black bass, stripers, channel and yellow catfish, crappie, and sunfish. Largemouth bass and channel catfish were stocked when the reservoir was partially filled. The reservoir also holds alligator and longnose gar, shad, carp, blue and flathead catfish, white bass, and freshwater drum. The Devils River minnow is a U.S. endangered fish that existed in the rivers that feed into the reservoir before flooding, but its current status in the park is undetermined (see "Threatened, Endangered, or Special Concern Species" below for more information).

AMPHIBIANS AND REPTILES

No reptiles or amphibians were seen during a survey of Amistad National Recreation Area on May 12, 1993. No federally listed amphibians or reptiles have been recorded for Val Verde County. Two state threatened reptiles (indigo snake and Texas tortoise) have observed within the park (see "Threatened, Endangered, or Special Concern Species" below for more information).

AQUATIC INVERTEBRATES

Amistad's 1995 biological survey does not list aquatic invertebrates. Generally, the abundance and type of organisms present depend on the water quality and habitat conditions within Lake Amistad. The Amistad shoreline has little to no aquatic vegetation, reducing the potential diversity and density of shoreline aquatic invertebrates. Also, because Amistad is fed by several rivers, the relatively high

turnover rate within the reservoir is likely to reduce its productivity, as compared to other mesotrophic or eutrophic Texas lakes, which are not riverine ecological systems. Thus, the diversity and abundance of invertebrates along the Amistad shoreline is expected to be low.

THREATENED, ENDANGERED, OR SPECIAL CONCERN SPECIES

WILDLIFE SPECIES

Wildlife species listed by the U.S. Fish and Wildlife Service that may occur in or near Amistad National Recreation Area are listed in Table 10 (NPS 1997b).

TABLE 10: FEDERAL AND STATE LISTED WILDLIFE THAT MAY OCCUR IN AMISTAD NATIONAL RECREATION AREA

Common Name	Scientific Name	State Status*	Observed in National Recreation Area	Habitat Present at or near Shoreline
FEDERAL ENDANGERED SPECIES				
BIRDS				
American Peregrine Falcon	*Falco peregrinus anatum*	E	X	X
Black-capped Vireo	*Vireo atricapillus*	E	X	
Brown Pelican	*Pelicanus occidentalis*	E	X	
Interior Least Tern	*Stema antillarum athalassos*	E	X	X
Whooping Crane	*Grus americana*	E		
FISHES				
Devils River Minnow	*Dionda diaboli*	T		
FEDERAL THREATENED SPECIES				
BIRDS				
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	T(SA)		X
Bald Eagle	*Haliaectus leucocephalus*	E	X	X
Piping Plover	*Charadrius melodus*	T		
FEDERAL CANDIDATE SPECIES				
BIRDS				
Mountain Plover	*Charadrius montanus*			
FEDERAL SPECIES OF CONCERN				
AMPHIBIANS				
Texas Salamander	*Eurycea neotenes*			
BIRDS				
Audubon's Oriole	*Icterus graduacauda audubonii*			
Black Tern	*Chlidonias niger*		X	X
Ferrunginous Hawk	*Buteo regalis*		X	
Mexican Hooded Oriole	*Icterus cucullatus cucullatus*		X	
Texas Olive Sparrow	*Arremonops rufivirgatus rufivirgatus*		X	
Western Burrowing Owl	*Athene cunicularia hypugea*		X	
White-faced Ibis	*Plegadis chihi*	T	X	X
FISHES				
Blotched gambusia	*Gambusia senilis*	E		*
Blue sucker	*Cycleptus elongatus*	T	X	
Chihuahua shiner	*Notropis chihuahua*	T		
Conchos pupfish	*Cyprinodon eximius*	T		
Proserpine Shiner	*Cyprinella proserpina*	T	X	
Rio Grande Darter	*Etheostoma grahami*	T	X	
Rio Grande Shiner	*Notropis jemezanus*		X	
INVERTEBRATES				
Salina Mucket	*Disconaias salinasensis*		X	
Texas Hornshell	*Popenaias popei*		X	
Mexican Fawnsfoot	*Truncilla cognata*		X	
MAMMALS				
Cave Myotis	*Myotis velifer*		X	X
Greater Western Mastiff	*Eumops perotis californicus*			X

Common Name	Scientific Name	State Status*	Observed in National Recreation Area	Habitat Present at or near Shoreline
Pale Townsend's (Western) Big-eared Bat	*Plecotus townsendii pallescens*		X	X
Yuma Myotis	*Myotis yumanensis*		X	X
REPTILES				
Reticulate Collared Lizard	*Croataphytus reticulatus*	T		
Texas Horned Lizard	*Phrynosoma cornutum*	T	X	X
STATE ENDANGERED SPECIES				
FISHES				
Phantom Shiner	*Notropis orca*			*
Bluntnose Shiner	*Notropis simus*			
MAMMALS				
Black Bear	*Ursus americanus*		X	
STATE THREATENED SPECIES				
BIRDS				
Zone-tailed Hawk	*Buteo albonotatus*			
Wood Stork	*Mycteria americana*			
REPTILES				
Texas Indigo Snake	*Drymarchon corais erebennus*		X	
Texas Tortoise	*Gopherus berlandieri*		X	
Big Bend Blackhead Snake	*Tantilla rubra*			
STATE SPECIAL CONCERN SPECIES				
MAMMALS				
Hairy-legged Vampire Bat	*Diphylla ecaudata*		X	X

SOURCES: U.S. Fish and Wildlife Service, Oct. 17, 1997; Texas Parks and Wildlife Department, Sept. 7, 1996. Habitat column: D. Larson, NPS, pers. comm., P. Steinholtz, URS, Nov. 4, 2002.

E = Endangered Species; T = Threatened Species, SC = Special Concern Species; T(S/A) Threatened due to similarity of appearance.

* This species is considered extinct in the U.S.

The beaver is listed as an endangered species by Mexico but not by the United States or Texas. The park has not been contacted by Mexican counterparts concerning providing protection for beaver in Lake Amistad (D. Larson, NPS, pers. comm., P. Steinholtz, URS, Sept. 9, 2002).

With regard to the federal status species, the American peregrine falcon, black-capped vireo, brown pelican, interior least tern, and whooping crane (all listed as endangered) may occur within Amistad National Recreation Area. The arctic peregrine falcon, bald eagle, and piping plover, and Devils River minnow (all listed as threatened) may also occur within the park (NPS 1997b).

Federal Endangered Species

Birds. *American Peregrine Falcon* — Confirmed sightings of the American peregrine falcon occurred in 1991, 1992, 1993, 1994, and 1998. The American peregrine is a resident of the Trans-Pecos region (which includes the Amistad Reservoir area). They use habitat over the water and the shoreline edge. However, according to park staff, falcons only migrate through Amistad (D. Larson, NPS, pers. comm., P. Steinholtz, URS, Nov. 4, 2002, re: T&E species). Peregrine falcons prefer meadows, mudflats, beaches, marshes, and lakes where birds are abundant. They nest on cliff edges (NPS 1997b).

Black-capped Vireo — The first and only confirmed sighting of a black-capped vireo in the park was made on April 24, 1993, in the Rough Canyon district. It is believed that the vireo was passing through the park, following Devils River Canyon en route to known nesting areas outside the park. The vireo's preferred habitat is low brush on steep slopes in the vicinity of dry streambeds (NPS 1997b).

Brown Pelican — Six brown pelicans were observed on December 21, 1989, inside the park near the Rough Canyon Marina. One bird was observed flying with a group of white pelicans on the Devils

River in the summer of 1991. One bird was sighted on the Rio Grande arm of the reservoir from April to May 1992. Additional sightings occurred in September and October 1996, also on the Rio Grande arm of the reservoir. One brown pelican was observed in October 1997 flying between Scuba Cove and Diablo East Harbor. There are no documented records of brown pelicans nesting at Amistad Reservoir. The pelicans feed directly over the water on fish from the reservoir (NPS 1997b).

Interior Least Tern — Approximately 80 to 160 interior least terns arrive at the reservoir in April or May of each year and nest on several of the exposed islands in the park. They leave in mid to late August. Their preferred nesting habitat is a gravelly surface with no vegetation, and they return to the same general areas of the lake each year. They prefer islands that have been recently exposed as a result of lower lake levels because there is no vegetation. The terns feed in shallow waters adjacent to the islands, diving into the water in search of small fish (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Aug. 22, 2002, re: least tern islands).

The "Superintendent's Compendium" closes all least tern nesting colony sites to the public. To further protect terns from human disturbance, including motorized and nonmotorized boat and PWC users, signs are posted in approximately 18 inches of water adjacent to the nesting islands to warn all visitors to stay away. Placing warning signs in water (rather than on the islands) prevents employees or visitors from accidentally stepping on eggs (which resemble rocks) or hatchlings, which "freeze" when threatened and camouflage with the background. The signs are placed as soon as staff can determine that the terns are using a specific island for nesting, and they are removed at the end of August after the terns have left (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Aug. 22, 2002, re: least tern islands).

Park staff are aware of no instance when someone has knowingly beached a boat and walked onto a nesting island marked with park warning signs. Visitors do not seem to mind the nesting island closures. The park has enough islands and shoreline for visitors to use that they are not affected by the closures (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Aug. 22, 2002, re: least tern islands).

No extra law enforcement efforts have been required to monitor the tern nesting sites, but park staff check the posted nesting islands during boat patrols to ensure no boats or people are on the island disturbing the terns (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Aug. 22, 2002, re: least tern islands).

Whooping Crane — No sightings of whooping cranes have been confirmed at Lake Amistad. However, one sighting was confirmed in Big Bend National Park flying; it was suspected that the bird was using the Rio Grande as a flyway. It is possible that the crane would fly through the boundaries of Amistad Reservoir. The whooping crane is listed as a migratory species that might fly through Val Verde County (NPS 2002d). Its habitat includes large wetland areas (TPWD 2002).

Fishes. *Devils River Minnow* — The Devils River minnow is a U.S. threatened fish that existed in the rivers that feed into the reservoir before the dam was constructed, but its current status in the park is undetermined. The Devils River minnow has not been collected from Amistad Reservoir. This fish requires flowing water, and is not found in standing water, such as a reservoir. It exists in small stream channels of the Devils River, the bottom of which consists of a limestone bed in areas outside the flooded boundary of the reservoir. This limestone bed makes access by boats, including canoes, extremely difficult (D. Larson, NPS, pers. comm., P. Steinholtz, URS, Oct. 3, 2002).

Federal Threatened Species

Birds. *Arctic Peregrine Falcon* — The arctic peregrine falcon is listed for Amistad Reservoir at the request of the U.S. Fish and Wildlife Service due to its similar appearance to the American peregrine falcon. There have been confirmed sightings of peregrine falcons at Amistad Reservoir, but no documented proof of any nesting activity (NPS 1997b).

Bald Eagle — Adult bald eagles, seen singly or occasionally in pairs, are observed nearly every winter along the cliffs of the Rio Grande near, upstream, and downstream from the confluence with the Pecos River. Sightings are usually made between October and February, with confirmed sightings each year from 1987 through 1993. A single adult was sighted on February 21, 1996, flying along the Rio Grande about 5 miles downstream of the mouth of the Pecos River. There are no documented cases of bald eagles nesting in the Amistad Reservoir area. An immature bald eagle was sighted near the U.S. Highway 90 bridge near the Governors Landing campground on September 26, 1997, and was observed again in the general area on October 29, 1997 (NPS 1997b). Bald eagle habitat consists of rivers and lakeshores with large, tall trees (TPW 2002).

Piping Plover — There have been no confirmed sightings of piping plovers at Amistad Reservoir. This species is listed for Amistad Reservoir at the request of the U.S. Fish and Wildlife Service because it is a migratory species that might pass through Val Verde County (NPW 1997). Habitat consists of sandy beaches and lakeshores (TPW 2002).

Federal Candidate Species

Mountain Plover — No documented sightings of the mountain plover (a candidate species) have occurred in the park. However, it is possible that mountain plovers may occur in the park; they spend summer months in the Trans-Pecos region of Texas. The plovers prefer areas of freshly cut grass and might be observed in the area around Amistad Dam in short or freshly cut grass. Their habitat would not be the general shoreline (NPS 1997b).

Federal Species of Concern

Amphibians. *Texas Salamander* — Park records show that in 1961 a Texas salamander was documented 3.5 miles north of Del Rio in Four-mile Cave, which is south of the present San Pedro arm of the reservoir. There have been no recent documented sightings of this species inside the park. The salamander's habitat includes small subterranean streams, spring seepages, and the headwaters of creeks. No Texas salamanders were observed during a 1993 survey in the area of the Air Force Marina. However, specimens could be living below ground in sinkholes containing water (NPS 1997b).

Birds. *Audubon's Oriole* — No known sightings of Audubon's oriole have occurred in the park, although it is known to occur in Val Verde County. This species is probably more common in the Lower Rio Grande (NPS 1997b). According to park staff, the closest population of this species is south of Laredo, Texas, about 200 miles south of Amistad (D. Larson, NPS, pers. comm., P. Steinholtz, URS, Nov. 4, 2002). This species prefers habitat of dense brushland dominated by mesquite or Texas ebony (NPS 1997b).

Black Tern — A group of 15 to 20 black terns was observed at Amistad Reservoir in August 1994. There had been no confirmed sightings of this species at the reservoir prior to these sightings. The

black tern is an accidental visitor in Texas (NPS 1997b). Black tern habitats are lakes, ponds, marshes, and coastal areas (during migration) (Notebaert 2002).

Ferruginous Hawk. Single ferruginous hawks were observed in the park in 1985, 1988, and 1989. The Texas Parks and Wildlife Department considers this bird an irregular visitor. This species prefers to nest in conifers (which do not exist in the park), as well as cliffs, banks, buttes, or slopes (NPS 1997b).

Mexican Hooded Oriole — Mexican hooded orioles have been observed in the park. Sightings occurred between April 23 and April 26, 1993, at the Diablo East maintenance yard, Rough Canyon, the Spur 406 campground, and along the Rio Grande below the dam. They were also observed nesting adjacent to the dam in 1992, 1993, and 1994. This species prefers dense brushland dominated by mesquite or Texas ebony (NPS 1997b).

Texas Olive Sparrow — Approximately 12 Texas olive sparrows were observed along Spur 406 in and above the campground on April 25, 1993. About a dozen more were observed below the dam the following day. The olive sparrow is known to occur in Val Verde County and prefers a habitat of dense brushlands dominated by mesquite or Texas ebony (NPS 1997b).

Western Burrowing Owl — The western burrowing owl was sighted in the San Pedro campground area in 1975. A park ranger also observed this species along the access road into the campground from mid-November 1994 continuously through mid-March 1995. One individual was also seen at a burrow entrance (NPS 1997b). Habitat includes open, dry grasslands, agricultural and range lands, and desert habitats. They can also inhabit grass, forb, and shrub stages of piñon and ponderosa pine (CSU 2002).

White-faced Ibis — Three white-faced ibis were observed inside the park on September 20 and 22 of 1975 and November 1, 1975. Six individuals were counted in the Del Rio area in 1989. Small flocks of five to eight birds were seen in migratory flight west of Del Rio on September 19, 1987. This species probably occurs as a migrant through the park. It prefers a habitat of marshes, rice fields, and swamps. It is a wading bird that feeds on small crustaceans, insects, leeches, and small fish (NPS 1997b).

Fishes. Seven category 2 fish species are thought to occur in the park. Specific information from the Texas Natural Heritage Program (NPS 1997b) and other sources follows. All of these fish exist mostly in perennial streams. They are primarily restricted to a few sites upstream of the main body of the reservoir in small stream channels. They require flowing water and are not found in standing water, such as a reservoir. Inundation has limited their habitat range within the boundaries of the national recreation area (D. Larson, NPS, pers. comm., P. Steinholtz, URS, Oct. 3, 2002).

Blotched Gambusia — The blotched gambusia was once present in the Devils River but is now considered extirpated from the state of Texas and extinct in the United States, although it is still common in the Rio Conchos of Mexico (which enters the Rio Grande approximately 250 miles north of Amistad). Park records show that nine specimens were collected in 1958 from the upper portions of the old Devils Lake, which was inundated when the reservoir was filled in 1972. There is no record of this species in the park since 1972 (NPS 1997b).

Blue Sucker — The Texas Parks and Wildlife Department collected one blue sucker specimen from the reservoir in 1978 or 1979 during a fish sampling survey. The Texas Natural Heritage Program lists this species as occurring in Val Verde County. Its habitat consists of strong currents in deep (1–2.5 m.) chutes and main channels of medium to large rivers (NPS 1997b).

Chihuahua Shiner — No records show the Chihuahua shiner being collected in Amistad Reservoir. However, the U.S. Fish and Wildlife Service lists this species as possibly occurring in the Amistad Reservoir area. The range of this species includes the Rio Grande drainage in the Big Bend region of southwest Texas and northern Mexico (NPS 1997b).

Conchos Pupfish — There are no records of the Conchos pupfish being collected from the Amistad Reservoir area. However, the Texas Natural Heritage Program lists two occurrences of this species in Val Verde County, the second of which is on the Devils River a short distance upstream from the park boundary. It is possible that this species is present in the park in the area of the Devils River (not in the main body of Amistad Reservoir). Its habitat includes sloughs, backwaters, and the margins of small to medium rivers (NPS 1997b).

Proserpine Shiner — One proserpine shiner specimen was collected in the park on October 20, 1975 in a shallow spring in a Little Satan Creek tributary. The Texas Parks and Wildlife Department collected at least one specimen in December 1989 in San Felipe Creek, which is outside the park boundary. The department also lists five occurrences of this species in Val Verde County, one of which could be near the Amistad Reservoir. The range for this species is the Devils River, Lower Pecos River, and nearby tributaries of the Rio Grande. Its habitat includes rocky runs and pools, as well as creeks. The Texas Natural Heritage Program lists seven known occurrences of this species in Val Verde County, including Amistad Reservoir. Park records document that on June 28, 1974, one specimen was collected inside the park 1 mile south of the Air Force marina. Several specimens were also collected outside the park in December 1989 in San Felipe Creek, which flows into the Rio Grande downstream from the park boundary. It is thought to be common in the Devils River. Its range includes the lower Rio Grande drainage, Sycamore Creek, Devils River, and the lower Pecos River. Its habitat includes gravel and rubble riffles in creeks and small rivers (NPS 1997b).

Rio Grande Darter — There have been seven known occurrences of this species in Val Verde County, including Amistad Reservoir. Park records document that on June 28, 1974, one specimen was collected inside the park 1 mile south of the Air Force marina by a road culvert. Several specimens were collected outside of the park in 1989 in San Felipe Creek, which is in Del Rio and flows into the Rio Grande. The range for this species is the lower Rio Grande drainage in Texas and Mexico. It is common in the Devils River. Its habitat includes gravel and rubble rifles of creeks and small rivers (NPS 1997b).

Rio Grande Shiner — The Rio Grande shiner was common in the old Devils Lake on the Rio Grande prior to reservoir inundation in 1972. There are no records of this species having been collected at Amistad Reservoir since 1972. The current status of this species is undetermined. Its range includes the Rio Grande drainage in Texas and Mexico; it is thought to be common in the lower Rio Grande (NPS 1997b).

Invertebrates. *Salina Mucket, Texas Hornshell, Mexican Fawnsfoot* — Three freshwater mussels have been documented as occurring in Val Verde County and most likely in the area of Amistad Reservoir. A salina mucket specimen was collected alive in 1984 from the Rio Grande near Del Rio, Texas. The Texas hornshell has historically occurred along the Rio Grande, Pecos River, and Devils River. The endangered mussel can now only be found in Texas in the lower canyon area of Big Bend National Park. The Mexican fawnsfoot has historically occurred along the Rio Grande in Val Verde County (NPS 1997b, 2002c).

Mammals. The biological survey conducted in 1995 concluded that Lake Amistad is not likely to contain any important habitat area for any rare mammal. However, the presence of limestone caves provides potential habitat for bats.

Cave Myotis — The cave myotis is a year-round Texas resident, which spends summer months in the Trans-Pecos region. It is the most abundant bat of the Edwards Plateau, which is in south central Texas east of the Pecos River and west of the Colorado River. This bat usually roosts in caves and tunnels, and it often hibernates in the same sites as the Townsend's big-eared bat and Yuma myotis (see below). Specimens have been collected in a variety of areas within Amistad National Recreation Area along the Rio Grande and at the mouth of the Pecos River (Davis and Schmidly 2002; NPS 1997b).

Greater Western Mastiff — The U.S. Fish and Wildlife Service collected one greater western mastiff bat in the Langtry, Texas, adjacent to the Amistad park boundary. No recent sightings of this species have been confirmed, but it could be present in the park. This bat has been found near the Rio Grande in Val Verde. It inhabits rugged, rocky canyon country, and roosting sites always allow at least a 3-meter unobstructed drop for initiating flight. Mastiffs use habitat over the water and cliff edges, and they seek refuge in rock crevices or overhanging ledges in vertical or nearly vertical cliffs (NPS 1997b, D. Larson, NPS, pers. comm., P. Steinholtz, URS, Nov. 4, 2002, re: T&E species). Suitable habitat for this species exists throughout Amistad National Recreation Area, possibly in the vertical limestone cliffs that occur in the park (NPS 1997b). Rock outcrops with no soil development comprise about 15%–35% of the area (Davis 2002; TPWD 1995).

Pale Townsend's Big-eared Bat — Pale Townsend's big-eared bat specimens have been collected from within the boundaries of Amistad National Recreation Area (including the mouth of the Pecos River) and the Langtry area (NPS 1997b). These bats inhabit rugged, rocky canyon country and are common in caves and abandoned mine tunnels of the Trans-Pecos. They do not use rock crevices and cracks, as do many other species. These bats are intolerant of disturbance and will quickly abandon a roost site that has been disturbed (Davis and Schmidly 2002, NPS 1997b).

Yuma Myotis — Specimens of the Yuma myotis have also been collected from within the boundaries of Amistad National Recreation Area. It is a summer resident of the southern Trans-Pecos region and the area east of the Pecos River in Val Verde County. This bat is commonly encountered in lowland habitats near open water, where it prefers to forage. Most specimens collected in Texas have come from areas near the Rio Grande (NPS 1997b). Large nursery colonies may form in buildings, caves, mine tunnels, and under bridges from late May to early June. Nursery colonies are very sensitive and quickly abandoned if disturbed (Davis 2002; NPS 1997b).

Reptiles. *Reticulate Collared Lizard* — The reticulate collared lizard has not been observed in the park, but its range is believed to extend up the Rio Grande Valley into Val Verde County (NPS 1997b). It is a resident of thornbrush deserts, requiring open brush grasslands and thornscrub vegetation, and it is often found on scattered flat rocks below escarpments or isolated rock outcrops among scattered clumps of prickly pear cactus and mesquite (Davis 2002; University of Texas 2002).

Texas Horned Lizard — The Texas horned lizard prefers warm, sandy, arid environments and is typically found in flat, open areas with little vegetation. The lizard is active during the daytime until it retreats into shaded areas to avoid the most intense heat of the day. It was considered abundant at Amistad in the 1960s (NPS 1997b). Fourteen specimens were collected in 1966 during a reptile survey. Numbers dropped dramatically in the 1950s and 60s due to pesticide use. A reptile/amphibian survey was conducted in 1993 in the area of the Air Force Marina within the park, but no Texas

horned lizards were identified. However, a park ranger has recently observed this species in various areas of the park (Davis 2002; University of Texas 2002).

State Endangered Species

Fishes. *Phantom Shiner, Bluntnose Shiner* — Two state listed endangered fish (the phantom shiner and the bluntnose shiner) were thought to have occurred in Val Verde County, inhabiting the main channels of the Rio Grande in low velocity water and sandy substrate. However, the phantom shiner is thought to be extinct, and no park records indicate a specimen ever being collected in the park. No bluntnose shiner specimens have ever been collected in the park, either. One specimen of a subspecies was collected at the confluence of the Pecos River and Rio Grande some time before 1960. The species is now apparently found only in New Mexico (although not seen there since 1950), and it is no longer thought to occur in Texas (NPS 1997b). Like the U.S. listed fishes, these fish would occur mostly in perennial streams upstream of the main body of the reservoir and would require flowing water (D. Larson, NPS, pers. comm., P. Steinholtz, URS, Oct. 3, 2002).

Mammals. *Black Bear* — Only one state listed endangered mammal, the black bear, has been recently observed inside the park boundary (1994). Distribution in Texas is now restricted to remnant populations in mountainous areas of the Trans-Pecos region. Sightings in the park are rare and are thought to be of individuals who have crossed the Rio Grande from Mexico during drought situations. There were confirmed sightings of the Mexican species of black bear in the area of the park's 277 North campground in 1994. There were also confirmed sightings of black bears in the mid-1980s near the San Pedro campground area. However, the sightings were all of black bears passing through the area, and none of the bears remained for any length of time (NPS 1997b). Black bears have been restricted by human inroads to remote, less accessible mountainous areas or to nearly impenetrable thickets along water courses (NPS 1997b; Davis and Schmidly 2002).

State Threatened Species

Birds. *Zone-tailed Hawk and Wood Stork* — Two birds are listed as state threatened and could possibly visit the park. The zone-tailed hawk, a rare and local summer resident of the Rio Grande, has some potential to occur inside the park and might occasionally visit the area (NPS 1997b). Park staff have observed this hawk over the reservoir between 1998 and 2002. The last two observations were between Langtry and the Pecos River. They use habitat above the inundation zone, which is the elevation between current water level to the conservation pool (D. Larson, NPS, pers. comm., P. Steinholtz, URS, Oct. 3 and Nov. 8, 2002). The zone-tailed hawk's habitat consists of forested canyons and riverside woodlands (eNature 2002).

The wood stork is thought to occur in Val Verde County, but there are no data documenting a confirmed sighting in the park. It is considered an irregular visitor to Texas. It is possible that this species may occasionally pass through the Amistad area while traveling from central to northern Texas in late summer. It is unlikely that this species nests in the area because the nest is a platform of sticks in a tree in a swamp (NPS 1997b). Habitat includes freshwater and brackish wetlands, primarily nesting in cypress or mangrove swamps (USFWS 2002).

Reptiles. *Texas Indigo Snake* — The Texas indigo snake is a state threatened reptile that is found in the southern part of the state and is known to occur in the park. It has been observed along the Viewpoint Road, along the Spur 454 roadway, and in the area of the Spur 406 campground. It is likely that

this species can be found throughout the park (NPS 1997b). This snake prefers moist riparian breaks in thornbrush woodlands and mesquite savannah (University of Texas 2002).

Texas Tortoise — The Texas tortoise is another state threatened reptile that is known to occur in the park. An individual was observed on October 3, 1993, near the Diablo East ranger station. Other individuals have been observed near the IBWC project office. This species has been frequently observed near the IBWC office and work sites (NPS 1997b; University of Texas 2002). Its habitat includes well-drained, sandy soil.

Big Bend Blackhead Snake — Park records show no occurrences of the state-threatened Big Bend blackhead snake. However, the Texas Natural Heritage Program lists five occurrences of this species in Val Verde County. One of these listings is in Langtry, adjacent to the north side of the park. Another occurrence is listed as northwest of Del Rio, which could put it close to or inside the park boundary (NPS 1997b).

State Special Concern Species

Hairy-legged Vampire Bat — Texas lists one special concern species, the hairy-legged vampire bat, a mammal with potential for occurrence at Amistad. This species primarily inhabits tropical and subtropical forest lands, where its daytime retreat is normally a cave, but it has been found roosting in mine tunnels and hollow trees. The Texas Natural Heritage Program lists only one occurrence of this species in Val Verde County. Park records indicate that the only documented occurrence of this species in the United States was a single female specimen collected inside the park on May 24, 1967, from inside the lower railroad tunnel along the Rio Grande, 4 miles downstream of the confluence of the Rio Grande and the Pecos River. The single specimen extended the known range of this species approximately 725 km to the northwest of Tamaulipas, Mexico, where it is more often encountered (NPS 1997b; University of Texas 2002).

PLANT SPECIES

According to the U.S. Fish and Wildlife Service and the Texas Parks and Wildlife Department, Amistad National Recreation Area may provide habitat for 12 plants listed by the federal government and none listed exclusively by the state, as shown in Table 11.

Federal Endangered Species

Texas Snowbell — The federally endangered Texas snowbell is thought to occur in the park, but it has not been confirmed. Documented sightings have occurred in the Dolan Springs natural area, which is a short distance upriver from the park boundary on the Devils River. This plant is found only on limestone outcrops along perennial water courses in sycamore / willow woodlands, Texas oak woodlands, netleaf hackberry / little walnut woodlands, plateau liveoak / netleaf hackberry woodlands, or ashe juniper / oak woodlands (NPS 1997b).

Tobusch Fishhook Cactus — Like the Texas snowbell, the federally endangered Tobusch fishhook cactus is also thought to occur in the park, but has not been confirmed. Documented sightings have occurred in the Dolan Springs natural area. This cactus prefers very shallow gravelly soil in shortgrass grasslands among live oak / juniper woodlands on limestone uplands or occasionally in gravel along creek bottoms (NPS 1997b).

TABLE 11: FEDERAL AND STATE LISTED PLANT SPECIES THAT MAY OCCUR IN AMISTAD NATIONAL RECREATION AREA

Common Name	Scientific Name	State Status	Habitat Present at or near the Shoreline
FEDERAL ENDANGERED SPECIES			
Texas Snowbells	*Styrax texana*	E	
Tobusch Fishhook Cactus	*Ancistrocactus tobuschii*	E	
FEDERAL SPECIES OF CONCERN			
Cliff Bedstraw	*Galium correllii*		
Correll's False Dragon-head	*Physostegia correllii*		
Perennial Caltrop	*Kallstroemia perennans*		
Rydberg's Scurfpea	*Pediomelum humile*		
Sabinal Prairie-clover	*Dalea sabinalis*		
Sonora Fleabane	*Erigeron mimegletes*		
Texas Greasebush	*Forsellesia texensis*		
Texas Trumpets	*Acleisanthes crassifolia*		
Warnock's Rock-daisy	*Perityle warnockii*		
Wright's Water-willow	*Justicia wrightii*		

SOURCES: NPS 1997b; U.S. Fish and Wildlife Service, Oct. 17, 1997; Texas Parks and Wildlife Department, Sept. 7, 1996, D. Larson, NPS, pers. comm., P. Steinholtz, URS, Oct. 3, 2002.
E = Endangered Species; T = Threatened Species, SC = Special Concern Species

Federal Species of Concern

Ten U.S. listed plant species of concern are known to occur in Val Verde County and may occur within park boundaries; however, the park has no documented sightings of any of these plants inside the national recreation area (NPS 1997b). With the possible exception of the Correll's false dragon-head and the Wright's water-willow, these species exist outside of the reservoir inundation zone. Therefore, these species would not be found along the reservoir shoreline (D. Larson, NPS, pers. comm., P. Steinholtz, URS, Oct. 3, 2002). They are not adapted to inundation factors, and exotic species have taken over the shoreline.

Cliff Bedstraw — One known occurrence of cliff bedstraw was documented in Langtry, making it possible that this plant does occur in the park. Its habitat is the crevices of vertical canyon walls and is found only on massive limestone rock faces (NPS 1997b).

Correll's False Dragon-head — Two known occurrences of Correll's false dragon-head were documented in Val Verde County southwest of Del Rio. Its habitat is water along streams and in irrigation ditches, and it occurs only along perennially or seasonally wet areas. According to the Texas Natural Heritage Program, there is a high probability that this species exists in the park (NPS 1997b).

Perennial Caltrop — Two known occurrences of perennial caltrop were documented in Val Verde County; one in Shumla, one in Langtry. Shumla is a deserted town close to the park boundary between the Rio Grande arm and the Pecos River arm of the reservoir, making it possible that this plant occurs within the park, and the Texas Natural Heritage Program believes there is a high probability that this species does exist in the park (NPS 1997b).

Rydberg's Scurfpea — Known populations of Rydberg's scurfpea in Val Verde County include two in Rough Canyon and one southwest of Del Rio; the location of a fourth population has not been confirmed. The two populations in Rough Canyon could be inside the park, but that has not been confirmed. In March 1993 one population of the plant was located along U.S. Highway 277 several miles north of the park's 277 North campground. This population was on the highway right-of-way and not

inside the park boundary. According to the Texas Natural Heritage Program, there is a high probability that this species exists in the park (NPS 1997b).

Sabinal Prairie-clover — There are two known occurrences of sabinal prairie-clover in Val Verde County, both in Carruthers Draw, which is 30 miles north of Del Rio on U.S. Highway 277 outside the park. According to the Texas Natural Heritage Program, there is a high probability that this species exists in the park (NPS 1997b).

Sonora Fleabane — There are four known occurrences of Sonora fleabane in Val Verde County — one southwest of Del Rio, one southeast of Del Rio, one northeast of Del Rio, and one northwest of Del Rio. According to the Texas Natural Heritage Program, there is a high probability that this species exists in the park (NPS 1997b).

Texas Greasebush — One known occurrence of the Texas greasebush was documented in Val Verde County, but no further information is available. According to the Texas Natural Heritage Program, there is a high probability that this species exists in the park (NPS 1997b).

Texas Trumpet — There are two known occurrences of Texas Trumpet in Val Verde County — one northeast of Del Rio, the other in Carruthers Draw. The plant's habitat is dry soil along and near the Rio Grande in west Texas. According to the Texas Natural Heritage Program, there is a high probability that this species exists in the park (NPS 1997b).

Warnock's Rock-daisy — There are two known occurrences of Warnock's rock-daisy in Val Verde County — one in Pandale and one at Hackberry Crossing. Pandale is on the Pecos River approximately 40 miles upriver from the park boundary. This species occurs on massive limestone rock faces (NPS 1997b).

Wright's Water-willow — There are two known occurrences of Wright's water-willow in Val Verde County — one southwest of Del Rio, the other location is unavailable. According to the Texas Natural Heritage Program, there is a high probability that this species exists in the park (NPS 1997b).

SHORELINE VEGETATION

Lake Amistad is a man-made lake created when a dam was constructed on the Rio Grande in 1968; the lake level has fluctuated greatly since that time. As a result, very little shoreline vegetation exists. There is also little shoreline development at Amistad National Recreation Area. Roads provide access to certain areas of the shoreline, with the heaviest shoreline use concentrated near the boat ramps along the southeastern side of the park. The undeveloped shoreline consists primarily of limestone boulder, cobble, and gravel, and some areas of low shoreline cliffs. No functional wetlands exist at Amistad National Recreation Area (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Nov. 6, 2002, re: wetlands; D. Larson, NPS, pers. comm., P. Steinholtz, URS, Nov. 8, 2002, re: wetlands). In addition, no shoal formation has been detected in the park (J. Labadie and D. Larson, NPS, pers. comm., P. Steinholtz, URS, Aug. 15, 2002, re: scoping meeting).

For the first four months during 1992, the lake level was between 4 and 8 feet above the normal conservation level (1,117 feet), which was long enough to kill most native shoreline vegetation. Lake levels were also above the conservation pool for at least one month in 1987, 1988, 1989, and 1991. During 1974, the lake level was at 1,124 feet for at least six months (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Nov. 6, 2002, re: water levels). Lake levels have been receding since the spring of

1994. By the summer of 1998, Amistad Reservoir had dropped 56 vertical feet and covered less than 20% of the area that it had at normal lake water levels (Labadie 1999), increasing the amount of exposed, previously inundated shoreline. Dam construction also substantially altered the natural habitat at Indian Springs and its shoreline. No permanent and intact functioning riparian vegetation exists along the reservoir shoreline because of lake level fluctuations (see Figure 1). The lake level has been below the normal conservation level since May 3, 1993, and was 54 feet below the normal conservation level in September 2001. The dam operator tries to keep the lake level at an elevation of approximately 1,117 feet, but it is currently at 1,068 feet (a drop of 49 feet) because of drought. The fluctuating water table and steep rocky slopes common at Amistad do not provide the conditions necessary to support much growth of aquatic vegetation on the shoreline.

FIGURE 1: TYPICAL AMISTAD SHORELINE

Where shoreline vegetation does exist, mesic-adapted weedy species have developed in highly disturbed plant communities. Much of the shoreline vegetation currently consists of exotic species. The percentage of cover depends on the amount of time the limestone rock or silt is exposed. Areas exposed for months or years may support invasive nonnative species such as salt cedar (*Tamarix* sp.) and tree tobacco (*Nicotiana glauca*) (TPWD 1995). The inundation zone is dominated by two common plants: Bermuda grass (*Cynodon dactylon*), an exotic, and Texas frog-fruit (*Phyla incisa*), a native plant. Both can occupy large portions of the inundation zone and provide soil erosion protection from wave action (D. Larson, NPS, pers. comm., P. Steinholtz, URS, Oct. 2, 2002). Roosevelt weed (*Baccharis neglecta*), a native species, is also present (TPWD 1995).

Hydrilla, a nonnative submersed aquatic plant, is spreading rapidly through Texas waterbodies and is now well established in 85 Texas reservoirs, including Amistad. This plant roots on the bottom of lakes, rivers, reservoirs, ponds, and ditches in depths greater than 20 feet where water clarity is good. Hydrilla also prevents wave action from stirring up sediments and is credited with increasing visibility for Amistad divers (Amistad Scuba Divers 2002). Hydrilla, which is often considered a “severe pest” and is “illegal to possess” in Texas (Western Aquatic Plant Management Society 2002; North Texas Water Garden Society 2002) was likely introduced to Amistad as fragments on recreational boats (City

of Austin 2002; Western Aquatic Plant Management Society 2002). The park has made no efforts or plans to eradicate hydrilla from Lake Amistad.

Before it becomes too dense, hydrilla can provide good habitat for fish. It is eaten by waterfowl and is considered an important food source by some biologists. However, hydrilla can eventually rob the water of oxygen needed for a healthy aquatic community. Fish populations are negatively affected when hydrilla exceeds 30%–40% coverage in a waterbody. It can also interfere with recreational activities such as boating, and PWC operators avoid hydrilla because it can clog engines.

VISITOR USE AND EXPERIENCE

Amistad National Recreation Area is in a remote area of west Texas, and it is relatively undeveloped. Del Rio is near the southeast end of the recreation area. Del Rio shares a border with Ciudad Acuña in Mexico. The nearest large U.S. metropolitan areas are San Antonio (150 miles east) and San Angelo (150 miles north).

Between 1 million and 1.5 million people visit Amistad each year. Approximately 85% come for water-based recreational activities; the rest take advantage of camping and day use facilities (NPS 2001a). About two-thirds of all visitors are considered regional — from southwestern Texas and southern New Mexico, including Del Rio, San Antonio, San Angelo, Midland/Odessa, and Hobbs. The remainder are destination visitors from other areas, and "through" visitors traveling in west Texas and stopping at Amistad along the way. Visitors also come from Mexico, Houston, and Fort Worth, driving as long as 7–10 hours.

ANNUAL VISITOR USE

Visitor data for 1990 to 2001 indicate that visitation varies (see Table 12). Recreational visitation records for Amistad dating to 1979 indicate that the peak visitation of about 1.5 million visitors occurred from 1992 to 1995. Based on the data available, as well as discussions with recreation area staff, no increase in park visitation is anticipated over the next 10 years.

TABLE 12: AVERAGE ANNUAL VISITATION AT AMISTAD NATIONAL RECREATION AREA, 1990–2001

Year	Number of Visitors	Percentage Change from Previous Year
1990	1,306,474	--
1991	1,215,691	-6.9%
1992	1,559,659	+28.3%
1993	1,505,084	-3.5%
1994	1,591,903	+5.8%
1995	1,422,321	-10.6%
1996	1,238,990	-12.8%
1997	1,084,433	-12.5%
1998	1,129,811	+4.2%
1999	1,164,166	+3.0%
2000	1,234,506	+6.0%
2001	1,097,650	-11.1%
Average	**1,295,891**	**-0.8%***

SOURCE: NPS 2002e.

* Since 1990.

Census data for Val Verde County (in which Del Rio is located) and Bexar County (San Antonio) show a population change of 15.8% and 17.5% (respectively) between 1990 and 2000. The state of Texas changed by 22.8%, which is above the national population increase of 13.1% (U.S. Census Bureau 2002). While trends show that state population may continue to increase, park visitation is more difficult to predict.

Amistad visitation appears to vary depending on lake levels, which have been receding in recent years. Amistad Reservoir levels began dropping in 1994, and subsequent visitation shows a sharp decrease, with slight gains from 1998 to 2000, as shown in Table 12. However, lake level fluctuations affect visitors differently; for example, the park has seen a decrease in the numbers of swimmers and campers due to low lake levels, but an increase in motorboat and PWC users.

VISITOR DISTRIBUTION

Monthly visitor use is documented from 1979 to 2001 within the recreation area, which is open year-round. The highest visitor use occurs between March and September, with March and September often showing higher visitation than some summer months.

Because visitor use is distributed geographically throughout the reservoir, use was analyzed by type and location (see the Location map). Visitor use tends to concentrate close to the dam, where the water is deepest and where access from Del Rio is easiest. Table 13 shows visitor use distribution and activities throughout the park.

TABLE 13: VISITOR DISTRIBUTION, AMISTAD NATIONAL RECREATION AREA

	San Pedro Canyon	Diablo East	Devils River	Castle Canyon	Rio Grande	Pecos River
PWC Users	Large numbers. Almost every PWC user who launches from Spur 454 enters the canyon. Heavy PWC use at Spur 454 peninsula.	Largest numbers; heaviest PWC use.	Large numbers, especially north of Devils Shores subdivision and Indian Springs.	Fewer numbers.	Fewer numbers, especially north of buoy 28.	Few to none.
Non-PWC Boat Users	Large numbers.	Large numbers near Amistad Dam; heaviest boat use.	Large numbers, especially near Devils Shores subdivision.	Large numbers.	Fewer numbers; popular with houseboats.	Few during low water; primarily canoes.
Launch Location	Spur 454; 277 North (very little use during low water).	Diablo East, Governors Landing, South Winds Marina.	Primarily Rough Canyon; also Diablo East and Spur 454.	Spur 406.	Box Canyon, Diablo East, Governors Landing, South Winds Marina.	Pecos River ramp.
Swimmers	Three popular undesignated low-water swim areas; one high water beach (currently no use).	Three beaches popular when water is high; few to no swimmers at low water.	High water swim beach at Rough Canyon; no swimmers at low water.	None	None	None
Campers*	Two campgrounds plus two group campgrounds.	One campground.	No campgrounds.	One campground.	No campgrounds.	No campgrounds.
Other Possible Users	Birdwatchers, picnickers, wildlife observers, walkers.	Birdwatchers, picnickers, wildlife observers, walkers.	Birdwatchers, picnickers, wildlife observers, walkers.	Birdwatchers, wildlife observers.	Birdwatchers, wildlife observers.	Birdwatchers, picnickers, wildlife observers, hikers.

* Shoreline campers access and launch from all areas of the reservoir.

SEASONAL USE PATTERNS

Spring is the busiest visitor use period. In most years visitation begins to show an increase from March through June. Visitation in July and August decreases because of high temperatures and humidity. September sometimes shows a spike in visitation. Winter visitation decreases; however, boating and fishing are still popular during the winter months. For example, 461 boat trailers and 1 PWC trailer were counted at the Diablo East Marina in January 2002.

Watercraft use at Amistad, including personal watercraft, occurs most frequently during the spring on weekends. Holiday weekends at Amistad are crowded, particularly July 4. Watercraft use during the winter is less common.

VISITOR ACTIVITIES

Amistad supports a wide variety of boating activities throughout the year, including PWC use, powerboating, waterskiing, houseboating, boat fishing, sightseeing by boat, sailboating, sailboarding, canoeing, and kayaking. While recreational boating activities occur year-round, they increase during the summer due to warmer water temperature. Because these and other visitor activities may be affected by PWC use, they are discussed below.

Camping

The National Park Service operates four campgrounds at Amistad, located at 277 North (17 sites), San Pedro (35 sites), Governors Landing (15 sites), and Spur 406 (8 sites). Several campgrounds are located near boat launches. At Spur 406, camping is permitted outside the developed area, but only within the posted campground boundaries. These campgrounds are open all year. Group camping (for a minimum of 15 campers) is permitted at Rock Quarry, San Pedro, and 277 North. Boaters also camp along the shoreline throughout the park, constituting the park's backcountry users. Over 500 fire rings have been documented throughout the park (outside designated campgrounds); usually they are along the shoreline and are used by boat campers (D. Larson, NPS, pers. comm., P. Steinholtz, URS, Sept. 9, 2002, re: backcountry use). The park is not aware of PWC users camping overnight on the shoreline, unless associated with a boat, houseboat, or both. Personal watercraft have minimal storage capability, so operators traveling without a boat would have to carry camping gear in a backpack, which park rangers have never seen (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Nov. 5, 2002, re: shoreline camping).

The number of campers has been decreasing. A high of 40,211 campground overnight stays were recorded in 1993, dropping almost in half to a low of 20,286 in 1998 and increasing slightly in 1999 to 21,237 (NPS 2001a). According to park staff, receding lake levels mean that three out of four campgrounds no longer provide a view of the lake, much less lakeside campsites (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Aug. 22, 2002, re: plans). Therefore, low water levels are likely related to decreased camper visitation.

Hiking

Although there are no established trails, hiking is permitted throughout Amistad National Recreation Area. Visitors are asked to obtain a copy of the park's official map and guide, which shows the park boundaries hikers must stay within. Several visitors regularly walk along the park roadways as a form

of exercise. This type of use occurs year-round, although it increases between November and April with the arrival of "winter Texans" (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 1, 2002).

Shoreline Use

Roads provide access to certain areas of the Amistad Reservoir shoreline. The heaviest shoreline use is near the boat ramps at Diablo East, South Winds Marina, Rough Canyon, and Spur 454. These ramps are concentrated near the southeastern side of the park, which has the best road access and is closest to Del Rio. The San Pedro Canyon area, which is near Diablo East and Spur 454, is popular with swimmers.

Swimming

Water temperatures at Lake Amistad range from 54°F in winter to 86°F in late summer, making it a popular destination for swimmers. Lake Amistad has several unsupervised swim beaches that are popular when lake levels are high (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 11, 2002, re: swimmers). These swim beaches include Rough Canyon, the dam, Scuba Cove, Governors Landing, and 277 North. Because lake levels have been so low, swimming has declined, sometimes dramatically, at these beaches. Swimmers no longer visit the Rough Canyon swim beach or the 277 North swim beach, and the dam swim beach has been closed. The Scuba Cove swim beach, which is near Diablo East, was once popular with divers and swimmers when the lake was full, but divers rarely visit it with such low lake levels, and about 10 to 15 swimmers visit the beach on busy summer weekends. Governors Landing has been the most popular beach and is still a busy swimming location, with about 30 to 50 swimmers on busy summer weekends. No swimming is permitted in harbors or from docks.

Several unofficial swim beaches have formed due to lowering lake levels, and these swim areas are in prime PWC use locations. The Spur 454 San Pedro Cliffs area is not a designated swim beach, but many visitors swim here now. Approximately 40 to 60 swimmers visit the area on busy summer weekends. The peninsula across the road from Spur 454 to the southwest of San Pedro Cliffs has become another popular swim area and is also popular with PWC users. Although this area is not a designed swim beach, approximately 20 to 30 swimmers visit the shoreline. The Horseshoe Cliffs area has become another popular, undesignated swim beach. This area is about 0.5 mile from San Pedro Cliffs on the San Pedro arm of the lake. All of the new swim areas are under water when lake levels are high.

Overall, the numbers of swimmers has decreased as the lake levels have receded.

Scuba Diving

Amistad's exceptionally clear water makes it an excellent place for scuba diving and is popular for divers wanting to become certified. Depending on lake levels, there are several submerged ranch houses to explore. Use at the Diablo East dive cove has decreased dramatically with receding lake levels. When lake levels were high, approximately 20 to 60 scuba diving students took certification dives on busy summer weekends. Divers must register with a park ranger or at park headquarters. Rental equipment is available in Del Rio. According to the rental shop, shore access is not as good as those areas that are accessible by boat (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 11, 2002, re: swimmers; Amistad Scuba Divers 2002).

Boat Tours

The park does not provide boat tours. A tour boat study was conducted in 1990, which recommended that the park allow an operator to provide interpretive tours at the Pecos River. This operator would be an entity that already had boats and experience providing interpretive tours. However, because of receding lake levels, the park now strongly advises that all boats, including jetboats, not attempt to travel the Pecos River upstream from the boat ramp. The only exceptions to this advisory are kayaks, canoes, and rafts.

Five private fishing guides and three boat tour guides (including one that conducts kayak and canoe tours) provide services on Lake Amistad. All but three operate from Del Rio. The others operate from Comstock, Texas, which is east of the mouth of the Pecos River.

Watercraft Use (Motorboats, Canoes, and Sea Kayaks)

A variety of watercraft use Amistad Reservoir. Bass boats associated with fishing tournaments comprise a large portion of the boating activity at Lake Amistad. Lake Amistad is among the top 10 bass fishing lakes in Texas, attracting anglers from all over Texas and occasionally from other states as well. The largest bass tournaments have attracted as many as 550 boats for a single tournament weekend, and many smaller bass tournaments of 60 or less boats are held at the lake nearly every weekend. On some weekends there may be as many as 12 small bass tournaments. The Amistad Web site shows that six different fishing clubs scheduled a tournament on September 14, 2002, for a total of 208 boats. During bass tournaments, anglers tend to fish the entire lake, but concentrate less on the upper Devils River, the Pecos River, and the upper Rio Grande (NPS 2002b). Most fishing is done from boats, and anglers seldom go ashore. Very few areas of the park are accessible by road, which precludes much fishing from the shore.

Recreational boats not associated with bass tournaments comprise another large portion of the boating activity at Amistad. These users come to water-ski, sightsee, relax, swim, camp, hunt, and fish (non-tournament fishing). Recreational boating activities occur year-round, increasing during the summer due to warmer water temperatures. PWC users fall into this category of recreational boat use.

Nonmotorized watercraft comprise a third category of recreational boating. These watercraft include sailboats, sailboards, canoes, and kayaks. Sea kayakers and canoeists comprise very small numbers of visitors. Sailboaters prefer the large area of water in front of the Diablo East Harbor. They also travel to the mouth of the Devils River and up the Rio Grande as far as the Box Canyon boat ramp area. Sailboarders tend to launch from the Governors Landing swim beach area because the prevailing southeast winds are at their backs, making it easier to travel away from the shore and into the reservoir. Canoes and kayaks primarily travel the Devils River, although some use the Pecos River, even at low water levels (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Oct. 2, 2002, re: other boaters).

One private boat tour operator provides kayak and canoe tours on Lake Amistad. He has a commercial use authorization and works out of Comstock, just east of the mouth of the Pecos River. He rents two large canoes, which seat 18 to 20 people, and approximately 10 to 15 regular sized canoes. Renters usually canoe the Pecos or Devils Rivers (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Aug. 30, 2002, re: canoe rentals).

The national recreation area has several boat ramps that are designated launching sites:

- Diablo East
- Rough Canyon
- Air Force (South Winds Marina)
- Box Canyon
- Blackbrush Point
- 277 North Campground
- 277 South
- Pecos River
- Spur 406 Campground
- Spur 454
- Steam Plant Road

Of the 11 ramps listed above, the first three are primarily used by PWC operators. The 277 North and South ramps and the South Winds (Air Force) Marina are currently closed due to low lake levels (see Figure 2). The Pecos River and Spur 406 are used primarily by small, flat-bottom johnboats. The park is currently "strongly advising" that no boats attempt to travel the Pecos River upstream from the ramp because water flow is low and aquatic vegetation has choked the river. The only exceptions to this advisory are kayaks, canoes, and rafts. Boating visitors choose destinations based on which boat ramp they use, planned activities, current lake level, and time of year.

FIGURE 2: HIGH WATER BOAT RAMP

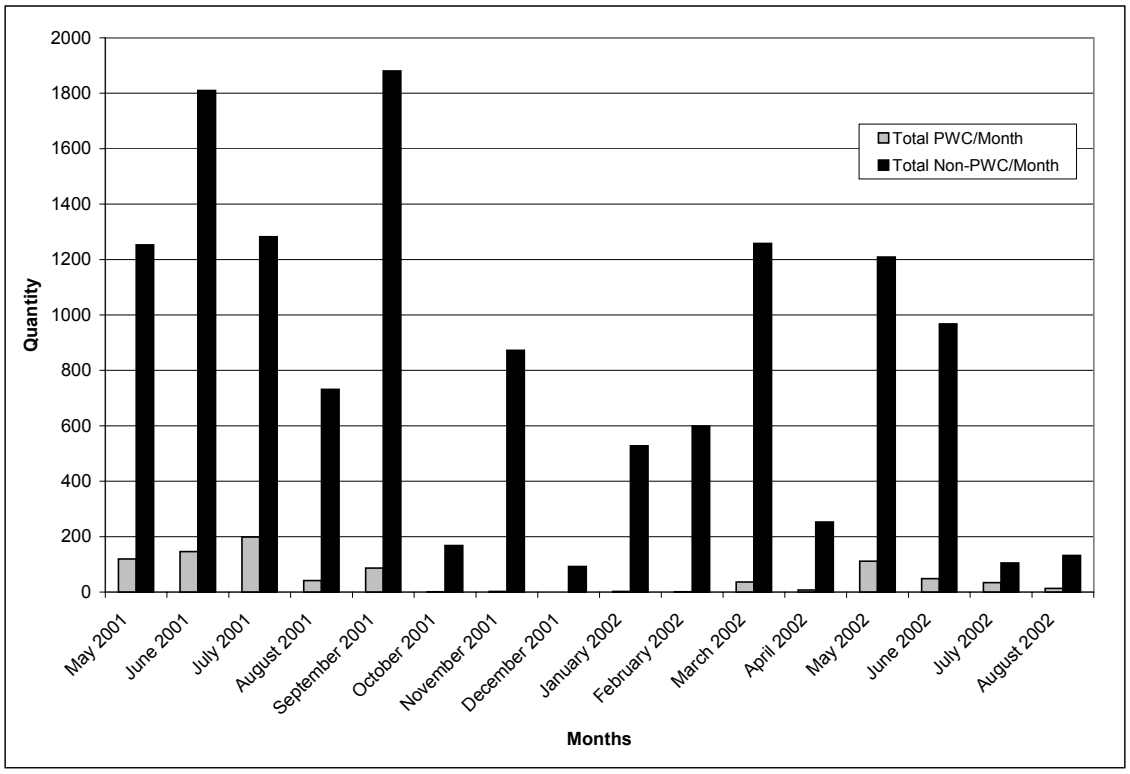
PWC Use

Recreational Use and Activities. PWC use falls into the category of recreational boating activity. According to trailer counts conducted monthly by park staff from May 2001 to August 2002, PWC use comprises about 6% of all motorized boat use at Amistad (Garetz 2002b).

The park began regularly documenting PWC use July 4, 1992, but the earliest record is from March 1989, when a violation notice was issued to an operator for reckless and negligent behavior near a swim beach. PWC use became more common in 1990 to 1991, and in May 2001 park staff began regularly collecting PWC use data by counting the number of PWC and non-PWC trailers in parking lots at launch ramps. The highest use generally occurs in summer from Friday through Sunday, and in 2001 ranged from as low as 1 personal watercraft per day to approximately 30. Park staff believe that PWC use is increasing, but only slightly — approximately 1.5% per year based on observations (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 19, 2002, re: Amistad numbers).

Data collected between 2001 and 2002 show that PWC users are a consistent part of the total boating population of the lake, and holidays show the highest amount of use. Figure 3 shows PWC use compared to total boat use. The highest PWC-use weekday was Wednesday, July 4, 2001 (a holiday), when 33 PWC trailers were observed parked at boat ramp parking lots throughout the recreation area. On that same day, 88 non-PWC boat trailers were observed in the same parking lots.

FIGURE 3: PWC AND BOAT USE AT AMISTAD NATIONAL RECREATION AREA



The highest use for a non-holiday weekend occurred on Saturday, June 23, 2001, when 26 PWC trailers were observed in parking lots throughout the recreation area, compared to 270 non-PWC boat trailers in the same parking lots. Visitors were attracted by the 12 largemouth black bass tournaments taking place at the lake that day and the pleasant weather conditions (bass tournaments occur every weekend during the summer). The highest holiday weekend use day was Sunday, May 26, 2002, when 38 PWC trailers (and 296 non-PWC boat trailers) were observed at launch ramps.

On busy summer weekends, PWC use can comprise between 8% and 20% of total boating activity (NPS 2002b). On summer weekdays this percentage tends to increase due to fewer out-of-town bass tournament fishermen on the lake. PWC use on summer weekdays can comprise between 19% and 40% of total boating activity in the evenings after 6:30 P.M., when local PWC owners visit the lake after work.

PWC operators land on the shoreline in the southeastern end of the park, particularly around the San Pedro area (Spur 454 boat ramp) to take turns riding their craft. Visitors can drive close to the shoreline here, which makes it easier to watch and ride personal watercraft.

Periods of PWC Use. PWC use occurs primarily between May and September, with April and October also showing steady visitation. Weekday PWC users are primarily local residents who arrive after work, while weekend users come from areas farther away. PWC users are usually on the water all day on weekends. Park staff have indicated that PWC users generally operate for two to three hours on weekday evenings, and from four to eight hours on weekends. The increased amount of time in the water can be attributed to users taking turns riding one craft (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 1, 2002).

PWC Use Areas. PWC operators have been observed traveling throughout the lake, either singly, in pairs, in small groups, or in association with a motorboat or houseboat. Within Amistad National Recreation Area, PWC use is allowed wherever motorized boats have access. This includes the arm of the Rio Grande, the Devils River, San Pedro Canyon, and the Pecos River.

PWC operators primarily launch from five boat launch areas (see Location map):

- In areas of concentrated use, such as the end of Spur 454 (which has a boat ramp), PWC users can drive close to shore, and there may be as many as 14 watercraft at this location in the evenings. This launch is the closest to the Del Rio city limits.
- Rough Canyon on the Devils River (which is a popular destination) has a cement ramp and paved parking lots. Devils River is one of the most popular PWC destinations, particularly Indian Springs.
- The Diablo East boat ramp near the U.S. Highway 90 bridge is close to the dam, has the largest parking area, and is the primary boat ramp. This area receives some of the highest boat use at the park and is the primary access point for bass tournament anglers. PWC operators launching from this area have been observed traveling throughout the lake.
- South Winds Marina (owned by the U.S. Air Force but open to the public) has a smaller parking lot with 28 spaces but can launch only 1 vessel at a time. PWC operators travel between this site and Diablo East Harbor.
- At the Box Canyon ramp at buoy 12 off U.S. 90, four boats could launch simultaneously. The road to the site is in bad condition and is used mostly by locals who own land nearby. PWC use is mostly near the launch ramps and in adjacent coves.

Personal watercraft reportedly do not launch from Spur 406, 277 North, 277 South, or Pecos River (G. Garetz, NPS, pers. comm., P. Steinholtz , URS, Sept. 1, 2002, re: water and use).

In addition to boat ramps and marinas, PWC users land at Governors Landing outside the swim beach area to change operators or passengers. They also land at Indian Springs in the upper Devils River to climb up to the springs or visit the cove downstream of Indian Springs to explore the area. Other popular PWC landing areas exist in Castle Canyon, where there are several coves used as a base of operations to change operators or passengers. Coves upriver and downriver from Box Canyon are also popular landing areas for changing operators or passengers. Rental houseboaters, as well as other boaters, travel everywhere along the lake to camp, where it is likely they hike along the shoreline. They photograph wildlife and scenery, swim, fish, or simply hike or look for shade trees. During hunting season, hunters gain access to hunt areas by boat, landing along the shoreline (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Oct. 3, 2002).

Areas of heaviest PWC use are Devils River north of buoy P and San Pedro Canyon east of buoy SPC-1. Most of the personal watercraft launching from Rough Canyon travel up Devils River. In addition, many personal watercraft launching from Diablo East and Spur 454 travel up Devils River past buoy P. In contrast, only one or two watercraft travel up the Rio Grande past buoy 28. No personal watercraft have been seen using the Pecos River (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 1, 2002, re: water and use).

The San Pedro arm of the lake (at the end of Spur 454) attracts a large number of PWC operators because it is one of the few areas where bystanders, usually friends and relatives of the PWC operators, can drive close to the shoreline to observe PWC activity or take turns riding. As a result, this location is one of the primary destinations for PWC operators.

Another popular destination for PWC operators is the Indian Springs area in the upper Devils River section of the lake. While en route to Indian Springs, PWC operators tend to either travel in a direct line or explore some or all of the coves between their launch and destination points. It is currently estimated that every personal watercraft launched from the Rough Canyon boat ramp travels north of buoy P on the Devils River (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 1, 2002 re: water and use).

People who rent the 56- to 65-foot houseboats from Amistad Lake Marina often tow personal watercraft with the houseboat (two or three personal watercraft have been observed being towed). The boats are permitted to travel to most areas, so PWC use is dispersed. The park estimates that about one-third to one-half of the PWC users who launch from the Diablo East boat ramp are associated with houseboats. These tagalongs are the only personal watercraft likely to use the upper Rio Grande area (north of buoy 28) (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 1, 2002 re: water and use).

Park staff have never seen personal watercraft used on the Pecos River. However, some PWC users may access the Pecos River without park staff knowledge. The park estimates that if PWC use occurs in the Pecos River, it would amount to less than 10 craft per year, if that much (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 1, 2002 re: water and use).

VISITOR SATISFACTION

Four hundred survey cards were distributed to a random sample of visitors in the park from February 1 to 28, 2001; less than 30 were returned, which is not enough to calculate a statistical response (E. Finkelstein, NPS, pers. comm., P. Steinholtz, URS, Nov. 7, 2002). However, of those who did re-

spond, 85% of were "satisfied overall with appropriate facilities, services, and recreational opportunities." The majority of visitors rated outdoor recreation as either very good (46%) or good (43%). The remainder (11%) rated outdoor activities as average. There are no local ordinances regarding PWC operation. However, 8% rated commercial services in the park as very poor, even though the majority of respondents rated these services as good (46%) and very good (23%).

VISITOR CONFLICTS AND SAFETY

RELATED FEDERAL AND STATE PWC REGULATIONS

PWC use within Amistad National Recreation Area is currently authorized in all areas where other watercraft are allowed. Operators of personal watercraft are subject to all applicable federal and state laws. Regulations applying to vessels include personal watercraft.

Amistad National Recreation Area is responsible for monitoring enforcement within the recreation area. The Texas Parks and Wildlife Code relating to PWC use is summarized below (Texas 2002):

1. Each occupant must wear a U.S. Coast Guard approved personal flotation device.
2. The cutoff switch (if provided) must be attached to the operator.
3. No PWC operation allowed between sunset and sunrise.
4. No PWC operations within 50 feet of any other vessel, person, stationary platform or other object, or shore, except at headway speed, without creating a swell or wake.
5. Operator must be 16 years of age, or be accompanied by a person at least 18 years of age; or must be at least 13 years of age and have successfully completed a boating safety course prescribed and approved by the state.
6. No PWC operation within any area where motorboat use is prohibited by state law or local rule or regulation.
7. No towing water skis, an aquaplane, a surf-board, a tube, or any other similar device, unless the craft is designed to carry a minimum of two persons.
8. No jumping the wake of another vessel recklessly or coming unnecessarily close to that vessel.
9. No operation in a manner that requires the operator to swerve at the last possible moment to avoid a collision.

The "Superintendent's Compendium" closes to public use Hidden Cave Cove, Painted Canyon, and Seminole Canyon (starting 0.5 mile from the mouth of the Rio Grande), which are all on the Rio Grande. In addition, least tern nesting colony sites are closed to the public, as well as "all water extending 300 feet from the concrete portion of the Amistad Dam." The Rough Canyon mooring cove is closed to the public, and time limits for mooring have been set at specific marinas. All motorboaters (including PWC operators) are required to purchase permits. Vessels are prohibited from operating within harbors, mooring areas, and any no-wake buoyed areas in excess of wake speed.

PWC-RELATED CONFLICTS WITH OTHER VISITORS

Texas boating regulations state that personal watercraft cannot be operated at full speed while within 50 feet of other vessels, people, or objects in the water. However, park staff have received complaints from other visitors about PWC operators who travel too close to fishermen, too fast at launch ramps,

or too close to swimmers. Several years ago the National Park Service installed "boats keep out" buoys at the San Pedro Cliffs, a popular swimming area at the end of Spur 454, to try to separate boaters and swimmers. However, the buoys were vandalized and cut from their tethers. Park staff have not replaced the buoys because the water is so deep (approximately 100 feet) in this area. Park staff have noticed a slight increase in PWC use, and more houseboat renters are towing personal watercraft (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Aug. 14, 2002).

The San Pedro Cliffs area, in addition to being a popular swimming location when lake levels are low, is a popular area for PWC use. No PWC/swimmer collisions or injuries have been reported in this area, but several swimmers have complained about PWC users coming too close and then moving farther away when park rangers come to the site.

The park has documented violation statistics from 1991 to 2001 (Garetz 2002a). The number of tickets issued to boaters and PWC users has decreased dramatically since 1991, partly because the water level has been low. Between 1991 and 1995 the number of tickets issued to boaters and PWC users averaged 21 per year, compared to 7 per year between 1996 and 2001. No tickets were issued to PWC users in 1998 and 2001. An average of 4 tickets per year were issued to PWC users between 1991 and 1995; an average of 1 ticket per year was issued to PWC users between 1995 and 2001. PWC tickets were typically issued for creating a wake, entering a closed area (particularly a swim beach), or operating in a reckless or negligent manner. The most recent tickets issued include several citations for operating without a permit.

Few PWC-related accidents have occurred at Amistad, with the exception of 1994, which included two near-drownings (operators were not wearing personal flotation devices), one broken clavicle (operator hit the handlebar), and one broken ankle (operator hit mirror). Two PWC operators collided in 1995, resulting in a broken finger and facial lacerations. An operator hit the handlebar in 1998 resulting in a broken arm, and an operator suffered a leg injury in 1999 after being hit by another personal watercraft.

Personal watercraft have the most potential for conflicts with other motorboaters because both user groups concentrate in the same areas (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 11, 2002, re: boats and PWC). Three areas of potential conflict include:

- The area near the Spur 454 boat ramp in San Pedro Canyon, where boats are continually launching from and returning to this boat ramp; PWC users also congregate here.
- The Devils River upstream from the Rough Canyon boat ramp is a narrow canyon and tends to get congested with boats on busy weekends. This is also a very popular area for personal watercraft, where they tend to travel in small groups of two or three.
- Boats and personal watercraft congregate in the area directly in front of the Diablo East harbor. Boats and personal watercraft are continually entering and leaving the harbor from the boat ramp and marina areas. PWC users also tend to linger in front of the mouth of the harbor.

No accidents or conflicts have been documented in these areas to date, but there is potential for conflicts or accidents due to concentrated use.

Many activities undertaken by visitors in the nearshore area of Amistad National Recreation Area are extremely compatible. For example, swimming, picnicking, and camping are all possible near the shoreline and produce little or no conflict between visitors. However, boating near swimmers can pose a safety conflict for both parties. As discussed under "Soundscapes," noise generated by personal watercraft can also affect visitor experiences.

In addition to visitor conflict concerns, PWC use within the national recreation area has resulted in the need for assistance to locate missing or overdue operators. While these occurrences are infrequent, there is the potential that a missing PWC operator could be in serious trouble. Thus far, missing or overdue operators have either arrived on their own or received NPS assistance (receiving fuel or being towed to the boat launch). However, the park is concerned about being able to adequately conduct search-and-rescue efforts should a PWC user become stranded in areas that NPS patrol boats cannot access, particularly shallow waters. The park's vast size and number of shallow coves and inlets could make rescue efforts difficult. Park rangers do not have authority or jurisdiction in Mexico; therefore, they are unable to assist visitors in Mexican waters,

CULTURAL RESOURCES

Prior to the flooding of portions of the Pecos, Devils, and Rio Grande valleys, the National Park Service and the University of Texas at Austin conducted nearly 10 years of cultural resource inventory work that documented more than 300 prehistoric archeological sites. Also, 22 major sites were excavated, producing a museum collection in excess of 1 million objects. NPS surveys in the 1980s of the Lower Pecos Canyon portion of the national recreation area covered about 90% to 95% of the federal property in this portion of the park. This area is included in the Lower Pecos Canyon Archeological District, which was listed on the National Register of Historic Places in 1971 and covers 34 acres; it includes 72 archeological sites, as well as the historic Lt. Bullis' Trail, which is considered eligible for listing but is not currently included in the district. Three other national historic districts are located within the national recreation area — Mile Canyon, which covers 1,500 acres and contains three sites; Rattlesnake Canyon, which covers 1 acre and contains one site; and Seminole Canyon, which covers 14,170 acres and contains 91 sites.

Reservoir levels began dropping in 1994, which exposed previously documented as well as new sites, and the park began drought-related archeological surveys around the reservoir in accordance with section 110 of the National Historic Preservation Act and Public Law 101-628. The survey re-investigated about 100 of the most important sites around the reservoir, resulting in the identification of more than 250 new sites overlooked during the 1960s pre-inundation research. A large number of the sites are within one of the national historic districts. Boaters have been "exploring" recently exposed archeological and historical sites around the reservoir, but the park has not been able to quantify the exact amount of damage that may be occurring as a result (J. Labadie, NPS, pers. comm., P. Steinholtz, URS, Oct. 1, 2002, re: accessible rock art). The park has developed only Parida and Panther Cave for access by water (boat or personal watercraft).

Fluctuating water levels pose a threat to cultural resources because water levels can increase or decrease 4 to 6 inches per day, and most water-related damage to archeological sites is caused by wave action. Wave action studies were conducted in relationship to effects on cultural resources. Sites identified in park surveys have been "affected by wave-action from high winds, passing boats, and fluctuating reservoir levels" (Labadie 1999). Wave action disturbances are not linked directly to PWC use. Winds are responsible for most of the wave action damage to cultural sites, especially during the winter, when winds upwards of 50 mph can cause major damage to sites along the southern shorelines (J. Labadie, NPS, pers. comm., P. Steinholtz, URS, Nov. 1, 2002, re: wave action). Some cultural resource areas exist on solid rock, high above the water level, so they are not disturbed by wave action. Ground slope is believed to be the primary determinant of the severity of wave action damage to archeological sites (Labadie 1999).

HISTORICAL BACKGROUND

According to the *Amistad National Recreation Area Cultural Resources Study* (NPS 1994), the pre-history of the lower Pecos River region (the intersection of the Pecos, Devils, and Rio Grande) includes the Paleoindian occupation (before 7000 B.C.), the Archaic period (7000 B.C. to A.D. 600), the Late Historic period (A.D. 600 to 1600), and the Historic period (since the close of the 16th century). The Lower Pecos River region rock art is considered to be comparable in significance to sites in Europe, Australia, and America's Baja California. The region contains some of the oldest dated and best preserved archeological deposits in North America. Several sites can be accessed by boat on the Pecos River and the Rio Grande, and less than a dozen on the Devils River. However, the majority of these sites are accessible by land vehicle and are located on private property (J. Labadie, NPS, pers. comm., P. Steinholtz, URS, Oct. 1, 2002; re: accessible rock art).

During historic times settlement was scattered, and there were no major towns. Spanish expeditions traveled through the Amistad Reservoir basin. By 1680 the Coahuiltecan groups native to the Amistad area were largely exterminated. Most historic American Indian populations associated with this region merely passed through en route to Mexico. The Lipan Apache and the Mescalero Apache might have sporadically occupied the area between 1680 and 1880. Several pictographs are attributed to Southern Plains Indian groups who traversed the region after 1680. In 1821, the region became part of Mexico.

The region comprising Amistad became part of the United States in 1848. A military camp and commercial and military transportation routes crossed the Amistad basin. The Southern Transcontinental Railroad opened west Texas and northern Mexico to commercial purposes and European settlement. Sheep and goat ranching quickly spread across the region. Overgrazing, deep-well drilling for water, and the suppression of natural grass fires lead to drastic environmental changes in the area. By World War II ranching had transformed much of the region into the scrub and thorn brush countryside that characterizes the area today. Ranching remains the economic cornerstone of the regional economy.

In 1944 the United States International Boundary Water Commission and the government of Mexico signed a joint water treaty that proposed to construct, operate, and maintain three international hydroelectric and flood control dams along the Pecos River, including Amistad. The National Park Service operated the Amistad Recreation Area primarily as a water-oriented recreation unit of the national park system under a cooperative agreement with the United States section of the International Boundary Waters Commission from November 11, 1965, to November 27, 1990.

ARCHEOLOGICAL RESOURCES

The *Amistad National Recreation Area Cultural Resources Study* (NPS 1994) states that the Lower Pecos River region contains one of the longest continuous records of human occupation in North America. Archeological research prior to the construction of Amistad Dam firmly established the existence of literally hundreds of prehistoric pictograph and archeological sties. Pre-inundation surveys, as well as reconnaissance surveys in the 1980s and low-water surveys in the 1990s, have collectively documented over 400 archeological sites within or near the national recreation area.

The lower Pecos River region contains one of the largest and densest concentrations of Archaic period pictographic rock art in North America. Of the 29 pictograph sites in the Lower Pecos Canyon Archeological District, 26 are on private property. Of the three rock art sites on federal property, only one has not been inundated by Amistad Reservoir. The oldest and most common pictograph style, the Pecos River style, features large (up to 13.1 feet) multicolored anthropomorphic figures in multiple

panels, which can cover more than 98.4 feet of rockshelter wall. Three pictographs have been dated to 3,000 to 4,200 years B.P.

An NPS rock art deterioration study established that many pictographs in the region are deteriorating, primarily due to natural causes (NPS 1995a). However, vandals have intentionally destroyed some sites, and early photographers unknowingly damaged the pictographs with water or kerosene to enhance contrasts. Other pictographs have been damaged by modern campfires or are submerged in Amistad Reservoir.

SUBMERGED CULTURAL RESOURCES

Prior to the flooding of portions of the Pecos, Devils, and Rio Grande valleys, the National Park Service and the University of Texas at Austin conducted nearly 10 years of cultural resources inventory work that collectively documented more than 300 prehistoric archeological sites. This work included the excavation of 22 major sites, which produced a museum collection estimated to contain in excess of 1 million objects (NPS 1994).

Amistad Reservoir water levels began dropping in spring of 1994 (Labadie 1999). By the end of summer 1998, Amistad Reservoir had dropped 56 vertical feet, covering less than 20% of the area it had at normal lake levels. In 1994 the park began drought-related reconnaissance-level archeological surveys in selected areas around the reservoir where visitor activities were greatest. The surveys quickly demonstrated that previously inundated sites, documented years earlier during pre-inundation research, were being exposed, and perhaps dozens of previously undocumented sites were appearing in predictable places along the 500-mile reservoir shoreline. Condition assessments at these newly exposed sites demonstrated that most of the observed effects were the products of natural forces (wind, water, and wave-action damage). Unintentional damage from grazing and visitor use activities (camping, off-road driving) were also taking a toll on the resources. Evidence of looting and vandalism appeared to be minimal. Two years later, a second assessment of looting and vandalism confirmed the initial assessments.

By the fall of 1996 nearly 100 miles of shoreline and intermittent drainages were surveyed, resulting in the identification and initial documentation of 72 previously unrecorded archeological sites. Combined with the results of other low-water surveys (1994–1996), a total of 112 undocumented and formerly inundated sites have been documented to date.

Boaters have begun “exploring” recently exposed archeological and historical sites around the reservoir, which could potentially result in looting or vandalism. PWC users would have the same access to these sites as any recreational boater. It is difficult to quantify the exact amount of damage that may be occurring (J. Labadie, NPS, pers. comm., P. Steinholtz, URS, Oct. 1, 2002; re: cultural resources access).

Information on the park Web site suggests that scuba divers explore the boat wrecks and several submerged ranch houses that were inundated by the reservoir.

ETHNOGRAPHIC RESOURCES

Ethnographic resources are defined as the natural and cultural materials, features, and places that are linked by a subject community to the traditional practices, values, beliefs, history, and/or ethnic identity of that community. At the present time, no Native American groups have expressed an interest in

the management of ethnographic resources at Amistad National Recreation Area, nor has any group requested participation in environmental management issues at the park. The park initiated ethnohistoric research in the mid 1990s to identify potentially affiliated Native American groups residing in the United States. This research was finally completed and published in late 2002 as an "Ethnohistoric Literature Review," which will form the basis for a future ethnographic affiliation study (Kenmotsu and Wade 2002).

SOCIOECONOMIC ENVIRONMENT

The Amistad Reservoir area is sparsely populated and somewhat remote. The nearest town is Del Rio. The nearest sizable cities are San Antonio and San Angelo. Laughlin Air Force Base is Del Rio's primary employer. Federal, state, and city agencies together comprise the next largest employers, followed by the San Felipe Water Treatment Plant.

The Lake Amistad Marina previously rented two PWC units, but has discontinued these rentals (this decision was not related to the scheduled closure to PWC use). According to an employee at the marina, no other local establishment rents personal watercraft, although the Air Force rents personal watercraft to active or retired military personnel from its South Winds Marina near Diablo East. Two other businesses that rented personal watercraft between 1993 and 1995 closed (Amistad Marina, pers. comm., P. Steinholtz, Aug. 20, 2002).

The Rough Canyon Marina does not rent personal watercraft, but it does sell gasoline to PWC users. PWC-related gas sales at this marina constitute 25% of its income 2001 (M. Mark Morgan, NPS, pers. comm., P. Steinholtz, URS, Sept. 18, 2002).

The primary increase in PWC use that park staff have noticed has been from houseboat renters who bring several of their own personal watercraft from home (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 7, 2002, re: water quality). According to park staff, "more than one" group of visitors who planned to rent houseboats at Amistad and bring their own personal watercraft cancelled their trips to the reservoir in September 2002 because they thought they could not bring their watercraft and were unaware that the ban had been delayed until November 6 (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Oct. 2, 2002, re: PWC visitation). The Lake Amistad Resort and Marina rents houseboats at Amistad Reservoir.

The majority of any economic impacts are expected to be concentrated in Val Verde County, particularly in the city of Del Rio. No companies in Del Rio currently rent personal watercraft, but a Honda dealer who sells them would be affected if PWC use was prohibited. Another company stores personal watercraft and another one services them (LAW et al. 2002). Many PWC units are probably privately owned and have been purchased in San Antonio, which is 150 miles east of the park. The park has no visitor use surveys to establish the percentage of sales, rentals, or income generated from PWC use.

There are few areas near Amistad National Recreation Area where personal watercraft may be used, unless users launched and operated their watercraft from the Mexican side of Lake Amistad.

NATIONAL RECREATION AREA MANAGEMENT AND OPERATIONS

The park has six law enforcement rangers, although the chief ranger works primarily in the park office. The other two rangers handle daily field operations. Recent staff additions will help the park enforce standards and limits (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Aug. 22, 2002, re: law enforcement).

However, the park shares a border with Mexico, and PWC violations can only be enforced on the U.S. side of the border. For example, personal watercraft operating on the Mexican side of the border could potentially cause conflicts with swimmers or other boaters on the U.S. side.

Park staff are also concerned about possible rescue expectations of PWC users who may launch from Mexico (if the ban remains in effect) and expect national park rangers to rescue or help them if they require assistance in Mexican waters. PWC users may not be aware that park rangers are not permitted to cross the international boundary line, even if visitors need help.

ENVIRONMENTAL CONSEQUENCES

SUMMARY OF LAWS AND POLICIES

Three overarching environmental protection laws and policies guide the National Park Service — the National Environmental Policy Act of 1969, and its implementing regulations; the National Parks Omnibus Management Act of 1998; and the NPS Organic Act.

1. The National Environmental Policy Act is implemented through regulations of the Council on Environmental Quality (CEQ) (40 CFR 1500–1508). The National Park Service has in turn adopted procedures to comply with the act and the CEQ regulations, as found in *Director's Order #12: Conservation Planning, Environmental Impact Analysis, and Decision-making* (2001), and its accompanying handbook.

2. The National Parks Omnibus Management Act of 1998 (16 USC 5901 et seq.) underscores the National Environmental Policy Act in that both are fundamental to NPS park management decisions. Both acts provide direction for articulating and connecting resource management decisions to the analysis of impacts, using appropriate technical and scientific information. Both also recognize that such data may not be readily available, and they provide options for resource impact analysis should this be the case.

   The Omnibus Act directs the National Park Service to obtain scientific and technical information for analysis. The NPS handbook for DO #12 states that if "such information cannot be obtained due to excessive cost or technical impossibility, the proposed alternative for decision will be modified to eliminate the action causing the unknown or uncertain impact or other alternatives will be selected" (sec. 4.4).

   Section 4.5 of DO #12 adds to this guidance by stating "when it is not possible to modify alternatives to eliminate an activity with unknown or uncertain potential impacts, and such information is essential to making a well-reasoned decision, the NPS will follow the provisions of the regulations of CEQ (40 CFR 1502.22)." In summary, the Park Service must state in an environmental assessment or impact statement (1) whether such information is incomplete or unavailable; (2) the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment; (3) a summary of existing credible scientific adverse impacts that is relevant to evaluating the reasonably foreseeable significant adverse impacts; and (4) an evaluation of such impacts based on theoretical approaches or research methods generally accepted in the scientific community.

3. The 1916 NPS Organic Act (16 USC 1) commits the Park Service to making informed decisions that perpetuate the conservation and protection of park resources unimpaired for the benefit and enjoyment of future generations.

GENERAL METHODOLOGY FOR ASSESSING IMPACTS

While much has been observed and documented about the overall effects of personal watercraft on the environment, as well as public safety concerns, site-specific impacts under all conditions and scenarios are difficult to measure and affirm with absolute confidence. Since personal watercraft were introduced in parks, data collected and interpreted about them, as well as their effects on park resources relative to other uses and influences, are difficult to define and quantitatively measure, despite monitoring.

Recognizing this dilemma, the interdisciplinary planning team created a process for impact assessment, based on the directives of the *DO #12 Handbook* (sec. 4.5(g)). National park system units are directed to assess the extent of impacts on park resources as defined by the context, duration, and intensity of the effect. While measurement by quantitative means is useful, it is even more crucial for the public and decision-makers to understand the implications of those impacts in the short and long term, cumulatively, and within context, based on an understanding and interpretation by resource professionals and specialists.

Potential impacts are described in terms of type (Are the effects beneficial or adverse?), context (Are the effects site-specific, local, or even regional?), duration (Are the effects short-term, lasting less than one year, or long-term, lasting more than one year?), and intensity (Are the effects negligible, minor, moderate, or major?). Because definitions of intensity (negligible, minor, moderate, or major) vary by impact topic, intensity definitions are provided separately for each impact topic analyzed in this document.

To determine impacts, methodologies were identified to measure the change in park resources that would occur with the implementation of the PWC management alternatives. Thresholds were established for each impact topic to help understand the severity and magnitude of changes in resource conditions of the various management alternatives. In the absence of quantitative data, best professional judgment was used to determine impacts. In general, the thresholds used come from existing literature on personal watercraft, federal and state standards, and consultation with subject matter experts and appropriate agencies.

Each alternative is compared to a baseline to determine the context, duration, and intensity of resource impacts. For purposes of impact analysis, the baseline is the continuation of personal watercraft use and current management projected over the next 10 years (alternative A).

In addition to establishing impact thresholds, the national recreation area's resource management objectives and goals (as stated in the "Purpose of and Need for Action" chapter) were integrated into the impact analysis. In order to further define resource protection goals relative to personal watercraft management, the park's *Strategic Plan* (NPS 2000d) was used to ascertain the "desired future condition" of resources over the long term. The impact analysis then considers whether each management alternative contributes substantially to the park's achievement of its resource goals, or would be an obstacle. The planning team then considered potential ways to mitigate effects of personal watercraft on park resources, and the alternatives were modified accordingly.

For the purposes of analysis, the following assumptions are used for all impact topics (the words "impact" and "effect" are used synonymously throughout the discussion):

Short-term impacts: Those impacts occurring from PWC use in the immediate future or through a single season of use, usually 1 to 6 months.

Long-term impacts: Those impacts occurring from PWC use over several seasons of use through the next 10 years.

Direct impacts: Those impacts occurring from the direct use or influence of PWC use.

Indirect impacts: Those impacts occurring from PWC use that indirectly alter a resource or condition.

Impact Analysis Area: Each resource impact is assessed in direct relationship to those resources affected both inside and outside the park, to the extent that the impacts can be substantially traced, linked, or connected to PWC use inside park boundaries. Each impact

topic, therefore, has an impact analysis area relative to the resource being assessed, and it is further defined in the impact methodology.

CUMULATIVE IMPACTS

The CEQ regulations to implement the National Environmental Policy Act require the assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for all alternatives, including the no-action alternative.

Cumulative impacts were determined by combining the impacts of the alternative being considered with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects at Amistad National Recreation Area and, if applicable, the surrounding region. These are described below:

- No local actions or laws have been established by the city of Del Rio or Val Verde County that affect PWC use at Amistad National Recreation Area. The park's *Strategic Plan* (NPS 2000d) contains a long-term goal of completing "10% of the natural resource inventories, studies, and planning documents identified in the *Resource Management Plan* and *General Management Plan*," such as the "Water Resources Scoping Report" (completed, NPS 2001a) and a cooperative fisheries management plan.
- The park currently has no plans to build additional boat ramps or access roads to the lake, which would result in an increase in visitor access and possible increase in overall visitation. The park replaced an existing boat ramp at Box Canyon, allowing four boats to launch at once instead of only one. However, the access road may never be paved (the road crosses private property and the owner opposes paving), so visitation at this ramp is not expected to increase dramatically.
- A program is underway to revise the *General Management Plan*. The team will examine the park's facilities and discuss the need for or the possibility of providing additional boat ramps, access points, campgrounds, picnic areas, etc. This is expected to be a three-year process, and it is too early to predict what, if any, changes will be made to park facilities.
- There are regional long-term plans to build some truck bypasses around Del Rio; the proposed alignment of the northside loop may come near present park headquarters. Proposed construction is expected to be completed by approximately 2012. The park is aware of no other plans or activities proposed or underway in the region.

IMPAIRMENT ANALYSIS

The NPS *Management Policies 2001* require an analysis of potential effects to determine whether or not actions would impair park resources. The fundamental purpose of the national park system, as established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. NPS managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adversely impacting park resources and values. However, the laws do give the National Park Service the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values. Although Congress has

given the National Park Service the management discretion to allow certain impacts within a park system unit, that discretion is limited by the statutory requirement that the agency must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values. An impact to any park resource or value may constitute an impairment, but an impact would be more likely to cause impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impairment may result from NPS activities in managing the park, visitor activities, or activities undertaken by concessioners, contractors, and others operating in the park.

The following process was used to determine whether the various PWC management alternatives had the potential to impair park resources and values:

1. The park's enabling legislation, the *General Management Plan,* the *Strategic Plan,* and other relevant background were reviewed with regard to the unit's purpose and significance, resource values, and resource management goals or desired future conditions.
2. PWC management objectives specific to resource protection goals at the park were identified.
3. Thresholds were established for each resource of concern to determine the context, intensity and duration of impacts, as defined above.
4. An analysis was conducted to determine if the magnitude of impact reached the level of "impairment," as defined by NPS *Management Policies.*

The impact analysis includes any findings of impairment to park resources and values for each of the management alternatives.

MOTORIZED WATERCRAFT USE PROJECTIONS FOR IMPACT ANALYSES

PWC use trends were identified to determine direct and indirect impacts of PWC management strategies on reservoir resources. Other visitor use trends were identified to help assess cumulative effects. Use trends were determined using data available from park visitation records, discussions with park staff, Texas boat statistics, and the 2001 visitor survey for Amistad. While the visitor survey data represent only those respondents surveyed, it provides the best data for general visitor trends. All visitor data, unless otherwise indicated, is presented as daily numbers.

The actual numbers of personal watercraft and other outboard motorboats using Amistad National Recreation Area were provided by Amistad park staff. For the analysis of impacts, an estimate of the highest PWC-use day was made from the data provided by park rangers. The highest use days between May 2001 through July 2002 are shown in Table 14.

TABLE 14: NUMBERS OF PERSONAL WATERCRAFT AND OTHER MOTORBOATS FOR HIGHEST USE DAYS, MAY 2001 THROUGH JULY 2002

Date	Number of Personal Watercraft	Number of Outboard Motorboats
May 26, 2001 (holiday weekend)	38	296
June 23, 2001	26	270
July 7, 2001 (holiday weekend)	26	125
September 1, 2001 (holiday weekend)	35	185
September 28, 2001	30	97
July 6, 2002 (holiday weekend)	34	75
Average	**32**	**175**

On average, 32 personal watercraft and 175 motorboats were used on a high-use day and were distributed between the two high-use areas — Amistad Reservoir and the Rio Grande (referred to as area 1) and Devils Canyon (area 2) — based on park staff observations and trailer counts.

Texas pleasure boat registration grew 0.42% between 1997 and 2001, although PWC registration in the state declined at an average annual rate of 12% during the same time period (A. Salazar, NPS, pers. comm. P. Steinholtz, URS, Sept. 9 and 17, 2002). National PWC registration trends also show a 3.9% decline, from 1,096,000 in 1999 to 1,053,560 in 2001. Despite national and statewide statistics, however, park staff believe that PWC use at Amistad is increasing, which may be a result of population increases in Texas. Therefore, under current trends a 1.5% yearly increase in PWC use and a 2% yearly increase in motorboat use at Amistad National Recreation Area are assumed, as shown in Table 15 (G. Garetz, NPS, pers. comm. P. Steinholtz, URS, Sept. 11, 2002, re: boat use and Sept. 19, 2002).

TABLE 15: PROJETED INCREASES IN PWC AND MOTORBOAT USE, 2002–2012

Year	Daily Average Number of Personal Watercraft*	Daily Average Number of Motorized Boats**
2002	32	175
2012	37	213

NOTE: Average usage based on six highest use days from May 2001 through July 2002 (Garetz 2002b).

* Use projected to increase by 1.5% per year.

** Use projected to increase by 2% per year.

WATER QUALITY

Most research on the effects of personal watercraft on water quality focuses on the impacts of two-stroke engines, and it is assumed that any impacts caused by these engines also apply to the personal watercraft powered by them. There is general agreement that two-stroke engines (including personal watercraft) discharge a gas-oil mixture into the water. Fuel used in PWC engines contains many hydrocarbons, including benzene, toluene, ethylbenzene, and xylene (collectively referred to as BTEX). Polycyclic aromatic hydrocarbons (PAHs) also are released from boat engines, including those in personal watercraft. These compounds are not found appreciably in the unburned fuel mixture, but rather are products of combustion. Discharges of all these compounds — BTEX and PAHs — have potential adverse effects on water quality. A common gasoline additive, methyl tertiary butyl ether (MTBE) is not used in Texas.

A typical conventional (i.e., carbureted) two-stroke PWC engine discharges as much as 30% of the unburned fuel mixture through the exhaust into the water (NPS 1999b; CARB 1999). At common fuel consumption rates, an average two-hour ride on a personal watercraft may discharge 3 gallons of fuel into the water (NPS 1999b). The Bluewater Network (2001) states that personal watercraft can discharge between 3 and 4 gallons of fuel over the same time period.

As described below, hydrocarbon (HC) discharges to water are expected to decrease considerably over the next 10 years due to mandated improvements in engine technology (US EPA 1996a, 1997).

GUIDING REGULATIONS AND POLICIES

The U.S. Environmental Protection Agency has developed national recommended ambient water quality criteria for approximately 120 priority pollutants for the protection of both aquatic life and human health (through ingestion of fish/shellfish or water) (US EPA 1999a). These criteria have been adopted as enforceable standards by most states. The Environmental Protection Agency has not established any criteria for the protection of aquatic life for any of the PWC-related compounds stated above. For the human health criteria, however, the Environmental Protection Agency has established criteria for benzene, ethylbenzene, toluene, and several PAH compounds. There are no criteria for xylene.

The NPS *Management Policies 2001* state that the Park Service will "take all necessary actions to maintain or restore the quality of surface waters and ground waters within the parks consistent with the Clean Water Act and all other applicable federal, state, and local laws and regulations" (sec. 4.6.3).

Amistad National Recreation Area does not have quantitative water quality data documenting the effects of personal watercraft since they were introduced in the 1970s. To address water quality impacts potentially resulting from continued PWC use, water quality benchmarks were used in the absence of unit-specific data as a basic principle to guide the analysis.

Simply stated, a water quality standard defines the water quality goals of a waterbody by designating uses to be made of the water, by setting minimum criteria to protect the uses, and by preventing degradation of water quality through antidegradation provisions. The antidegradation policy is only one portion of a water quality standard. Part of this policy (40 CFR 131.12(a)(2)) strives to maintain water quality at existing levels if it is already better than the minimum criteria. Antidegradation should not be interpreted to mean that "no degradation" can or will occur, as even in the most pristine waters, degradation may be allowed for certain pollutants as long as it is temporary and short term (G. Rosenlieb, NPS WRD, pers. comm., Tom Campbell, URS, 2001).

Other considerations in assessing the magnitude of water quality impacts is the effect on those resources dependent on a certain quality or condition of water. Sensitive aquatic organisms, submerged aquatic vegetation, riparian areas, and wetlands are affected by changes in water quality from direct and indirect sources.

While many parks do have established water quality monitoring programs, the specific organic compounds emitted from personal watercraft are not systematically measured. In the absence of park-specific data, available water quality benchmarks or criteria and estimated discharge rates of organics were used as the basic tools to address water quality impacts potentially resulting from PWC use.

METHODOLOGY AND ASSUMPTIONS

To assess the magnitude of water quality impacts to park waters under the various PWC management alternatives, the following methods and assumptions were used:

1. The regulation at 40 CFR 131.12(a)(2) represents an overall goal or principle with regard to PWC use in that the park will strive to fully protect existing water quality so that "fishable /

swimmable" uses and other existing or designated uses are maintained. Therefore, PWC use could not be authorized to the degree that it would lower this standard and affect these uses. To do so would potentially violate 40 CFR 131.10, which basically forbids the removal of an existing use (e.g., personal watercraft) because the activity was authorized knowing this level of pollution would occur.

2. State water quality standards governing the waters of the park were examined for pollutants whose concentrations in gasoline were available in the literature and for which ecotoxicological and/or human health benchmarks were available in the literature.

3. Baseline water quality data (if available), especially for pollutants associated with two-stroke engines (PAHs, hydrocarbons), were examined. In Texas, MTBE is not used in gasoline; therefore, it was not included in the analysis. PWC and other motorboats from other states utilizing MTBE as an additive may be found in the reservoir, but given the small numbers involved, this use was not considered in the calculations of water quality impacts.

4. Since no models were available to predict concentrations in water of selected pollutants emitted by personal watercraft and motorboats, an approach was developed to provide estimates of whether PWC (and outboard motor) use over a particular time (for example, over a typical busy weekend day) would result in exceedances of the identified standards, criteria, or toxicity benchmarks. The approach is described in appendix B. Results of this approach were then taken into account, along with site-specific information about currents, mixing, wind, turbidity, etc., as well as the specific fate and transport characteristics of the pollutant involved (e.g., volatility), to assess the potential for the occurrence of adverse water quality impacts.

5. In general, the approach provides the information needed to calculate emissions to the receiving waterbody from personal watercraft (and, by estimation, from outboard motors) of selected hydrocarbons whose concentrations in the raw gasoline fuel were available in the literature and for which ecological and/or human health toxicity benchmarks could be acquired from the literature. The selected chemicals were benzene and three PAHs (benzo(a)pyrene, naphthalene, and 1-methyl naphthalene). The approach outlined a procedure to first estimate the emissions of these pollutants to the water per operational hour (based on literature values) and to then estimate the total loading of the pollutants into the water, based on the estimated hours of use. The approach then provided an estimate of how much water would be required to dilute the calculated emission loading to the level of the water quality standard or benchmark. That volume of water (referred to as the "threshold volume of water") was then compared to the total available volume of water.

   The "Texas Surface Water Quality Standards" (TNRCC 2000) do not include aquatic life standards for typical gasoline organic constituents such as benzene or PAHs. Surface water quality standards for benzene and benzo(a)pyrene and human health protection are shown in Table 16.

TABLE 16: STATE OF TEXAS WATER QUALITY STANDARDS FOR ORGANIC POLLUTANTS

Chemical	Ingestion of Water and Fish (μg/L)	Ingestion of Fish Only (μg/L)
Benzene	5	106
Benzo(a)pyrene	0.099	0.81

Although water in Amistad National Recreation Area is not used for drinking, the designated use is public water supply (TNRCC 2000). Therefore, the standards for ingestion of water and fish were compared with US EPA standards, and the lower of the two sets of standards were used. Table 17 shows the benchmarks used to assess impacts.

TABLE 17: ECOTOXICOLOGICAL AND HUMAN HEALTH BENCHMARKS FOR ORGANIC POLLUTANTS

Chemical	Ecotoxicological Benchmark (μg/L)	Source	Human Health Benchmarks** (μg/L)	Source
Benzo(a)pyrene	0.014	Suter and Tsao 1996	0.0044	US EPA 1999a
Naphthalene	62	Suter and Tsao 1996	--	--
1-methyl naphthalene	34*	USFWS 2000	--	--
Benzene	130	Suter and Tsao 1996	1.2	US EPA 1999a

* Based on LC_{50} of 3400 μg/L for sheepshead minnow (34 μg/L used for freshwater calculations).

** Based on the consumption of fish and aquatic organisms.

6. The principal mechanisms that result in the loss of pollutants from the water also were considered. Many organic pollutants that are initially dissolved in the water volatilize to the atmosphere, especially if they have high vapor pressures, are lighter than water, and mixing occurs at the air/water interface. Other compounds that have low vapor pressure, low solubility, and high octanol/water partition coefficients tend to adhere to organic material and clays and eventually adsorb onto sediments. By considering movements of the organics through the water column, an assessment can be made as to whether there could be an issue with standards or benchmarks being exceeded, even on a short-term basis.

7. The threshold volume of water was calculated in acre-feet (1 acre-foot = 1 acre of water 1 foot deep). For example, if results showed that for benzo(a)pyrene, 55 acre-feet of water would be needed to dilute the expected emissions to below the benchmark level, and the receiving body of water is a 100-acre reservoir with an average depth of 20 feet (= 2000 acre-feet) and is well-mixed, then this would indicate little chance of a problem, especially when adding the effects of any other processes that contribute to the loss of benzo(a)pyrene from the water column. However, if the impact area is a 5-acre backwater averaging 2 feet deep (10 acre-feet), then there may be at least a short-term issue, especially if outboard emissions are added or there is little mixing in the area.

8. To assess cumulative impacts, outboard emissions also were determined, based on estimates of relative emissions of unburned fuel and hours of use. It was assumed that all engines currently used are two-stroke. Motorboat emissions were then added to PWC emissions to yield a more complete estimation of loading to the receiving waterbody. Inboards and the overall number of four-stroke engines in use contribute very little to the loading and were not included in the estimation. The estimates used for relative loading from various outboard engines are obtained from available data.

9. Reductions in emissions from personal watercraft and outboards are outlined by the U.S. Environmental Protection Agency over the next 16 years (see Table 18).

TABLE 18: ESTIMATED EPA REDUCTIONS IN WATERCRAFT EMISSIONS

Date	Action
1999	EPA requires production line testing for 75% HC reduction in new outboards and begins to see reductions as newer models are introduced (US EPA 1997).
2000	EPA requires production line testing for 75% HC reduction in new personal watercraft and begins to see reductions as newer models are introduced (US EPA 1997).
2006	EPA fully implements 75% HC reduction in new outboards and personal watercraft (US EPA 1996a).
2010	EPA estimates a 52% reduction in overall HC emissions from outboards and personal watercraft (US EPA 1996a).
2012	Approximately a 50% reduction in HC emissions estimated for this analysis, based on dates in US EPA (1996a, 1997).
2015	EPA estimates a 68% reduction in overall HC emissions from outboards and personal watercraft (US EPA 1996a).

Key dates in this chronology begin with 1999, when the U.S. Environmental Protection Agency began to require production line testing for 75% HC reduction in new outboard motors, and 2000, when production line testing for 75% HC reduction in new personal watercraft was required (US EPA 1997). These dates represent a delay in testing implementation that was originally scheduled (US EPA 1996a) for 1998 for both personal watercraft and outboard motors. By 2006 all new personal watercraft and outboards manufactured in the United States must have a 75% reduction in HC emissions (US EPA 1996a). For the purpose of estimating water quality impacts in this assessment, overall reductions in HC emissions are conservatively estimated to be 50% in PWC and outboard motors in 2012. This estimate is based on interpolations of the emissions reduction percentages and associated years (2010 and 2015) reported by the U.S. Environmental Protection Agency in 1996 (US EPA 1996a), but with a one-year delay in production line testing (US EPA 1997).

10. To evaluate water quality impacts at Amistad National Recreation Area, the total volume of the reservoir was estimated to 668,000 acre-feet within the United States, based on a pool elevation of 1,117 feet (IBWC 2002b). The reservoir was then divided into two areas according to where PWC use would be allowed under various alternatives, as described below:

    - The main body of Amistad Reservoir and the Rio Grande upstream of buoy 28 at the northwest end of the reservoir but still inside the recreation area (area 1) — 543,600 acre-feet (excluding the Devils River and San Pedro Canyon areas)
    - Devils River upstream of buoy P and San Pedro Canyon east of buoy SPC-1 (area 2) — 124,400 acre-feet

    These two areas were determined to be the most useful in the analysis of water quality impacts because of the higher relative levels of PWC and motorboat use in Devils River and San Pedro Canyon areas than in the main reservoir or the upper Rio Grande. The Pecos River, although inside the national recreation area, was not included in the analysis due to its very shallow depths and limited use by personal watercraft (G. Garetz, NPS, pers. comm., P. Steinholtz , URS, Sept. 1, 2002, re: water and use).

    The number of personal watercraft operating in different areas of the reservoir would vary by alternative. For example, no personal watercraft would be operated in the Pecos River, San Pedro Canyon, and the northern portions of the Devils River and Rio Grande under alternative B. The water volume in each subarea was determined from IBWC data (2002b), estimates of depths provided by park staff (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 1, 2002, re: water and use), and areas measured from maps of the national recreation area. Estimated volumes of each subarea and area are shown in Table 19.

TABLE 19: ESTIMATED WATER VOLUMES (ACRE-FEET)

Subarea	Estimated Area (acres)	Estimated Average Depth (ft)	Estimated Volume (ac-ft)
Rio Grande (upstream of buoy 28)	9,676	22	211,800[a]
Devils River (upstream of buoy P)	3,597	10	36,000
San Pedro Canyon (east of buoy SPC-1)	8,838	10	88,400
Pecos River	1,466	2	2,900[b]

a. Included as part of area 1 (543,600 ac-ft).

b. Not considered in the impact assessment.

11. The analysis assumes that the entire volume of the reservoir (668,000 ac-ft) is available for mixing/diluting PWC and motorboat emissions. However, this volume could be reduced by a

thermocline during the summer. The depth and strength of any thermocline varies with year and time of year, typically becoming established in the spring and continuing through the early fall. According to information provided by A. DeLaCruz (A. DeLaCruz, TCEQ, pers. comm., P. Steinholtz, URS, Oct. 9, 2002, re: thermocline), a thermocline was detected in June 2002 near a depth of 50 feet in the deepest area of the reservoir (near buoy 1 at the dam). With a maximum depth of approximately 100 feet near the dam and shallower depths of 60 feet at buoy 28 and 40 feet at buoy P in the Devils River, the available mixing zone volume in the presence of a thermocline would be more than half the total volume in the reservoir, or more than 271,800 acre-feet (half of 543,600 ac-ft). It is assumed that the other subareas do not have themoclines because of river flows and shallow depths. Because of the high number of variables in predicting a thermocline, the effect that a thermocline in the summer would have on mixing volumes is discussed qualitatively in the impact assessment.

12. For the assessment of impacts to water quality, the average numbers of personal watercraft and other motorboats were determined as explained in the "PWC Use Trends" section (page 84). For existing conditions this use is assumed to be distributed as shown in Table 20.

TABLE 20: CURRENT AND PROJECTED DISTRIBUTION OF PWC AND MOTORBOAT USE UNDER CURRENT CONDITIONS ON HIGH-USE DAYS

	Average Number of Personal Watercraft*		Average Number of Motorized Boats**	
Use Area	2002	2012	2002	2012
Amistad Reservoir and Rio Grande (Area 1)	14	16	115	140
Devils River and San Pedro Canyon (Area 2)	18	21	60	73
Total	**32**	**37**	**175**	**213**

Note: Average usage based on six highest use days from May 2001 through July 2002 (Garetz 2002b).

* Use projected to increase by 1.5% per year.

** Use projected to increase by 2% per year.

13. Personal watercraft are launched from several launch ramps in the recreation area, including Rough Canyon, Spur 454, Diablo East and Marina, South Winds Marina, and Box Canyon.

14. The majority of other motorboats operating within the recreation area are assumed to have two-stroke outboard engines. All motorboats are assumed to have engines larger than 15 horsepower. A number of houseboats operate on the reservoir but are not included since they are typically powered by four-stroke engines. Also, inboard and stern-drive motorboats are not included (G. Garetz, NPS, pers. comm., P. Steinholtz , URS, Sept. 5, 2002, re: noise and Sept. 7, 2002, re: water quality).

15. For a conservative assessment of available volume of water, no lateral mixing of water across the boundaries between areas was assumed. This assumption applied to areas within the United States (e.g., between San Pedro Canyon and Amistad Reservoir) and between U. S. and Mexican waters of the reservoir. In actuality, water and PWC emissions in each area will mix with adjacent waters to some unknown extent, thus reducing the concentrations of PWC emissions within each area. By assuming no mixing across the jurisdictional boundaries, the estimated impacts for each alternative are conservative (i.e., actual impacts are expected to be less than what is described in this analysis).

16. Boating activity, and therefore pollutant loads, would be distributed over an entire day, from early morning to dusk, although for the purpose of calculating impacts, it is assumed that personal watercraft and other motorboats operate for four hours a day. When released to water, benzene is subject to rapid volatilization, with a half-life for evaporation of about five

hours (US EPA 2001). The loss of benzene from the water column is discussed qualitatively where applicable.

Some research indicates that PAHs have phototoxic effects in oligotrophic lakes that have high light penetration (Oris et al. 1998). Limited data indicate that in these conditions, PAHs may have phototoxic effects on fish and zooplankton at very low concentrations (less than 1 µg/L). Because Amistad Reservoir is not considered oligotrophic (i.e., high light penetration), these toxic effects are not considered applicable to the reservoir.

IMPACT ANALYSIS AREA

The impact analysis area for water quality includes the jurisdictional boundary of Amistad National Recreation Area within the United States. The study area does not include the Mexican portion of the reservoir. Approximately 66% of the reservoir area is in the United States and 34% is in Mexico (NPS 2001a).

IMPACT TO WATER QUALITY FROM PWC USE

Given the above water quality issues and methodology and assumptions, the following impact thresholds were established to describe the relative changes in water quality (both overall, localized, short and long term, and cumulatively) under the various PWC management alternatives.

Negligible: Impacts are chemical, physical, or biological effects that would not be detectable, would be well below water quality standards or criteria, and would be within historical or desired water quality conditions.

Minor: Impacts (chemical, physical, or biological effects) would be detectable but would be well below water quality standards or criteria and within historical or desired water quality conditions.

Moderate: Impacts (chemical, physical, or biological effects) would be detectable but would be at or below water quality standards or criteria; however, historical baseline or desired water quality conditions would be altered on a short-term basis.

Major: Impacts (chemical, physical, or biological effects) would be detectable and would be frequently altered from the historical baseline or desired water quality conditions; and/or chemical, physical, or biological water quality standards or criteria would be slightly and singularly exceeded on a short-term basis.

Impairment: Impacts are chemical, physical, or biological effects that would be detectable and that would be substantially and frequently altered from the historical baseline or desired water quality conditions and/or water quality standards, or criteria would be exceeded several times on a short-term and temporary basis. In addition, these adverse, major impacts to park resources and values would

contribute to deterioration of the park's water quality and aquatic resources to the extent that the park's purpose could not be fulfilled as established in its enabling legislation;

affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or

affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

PWC use would continue within Amistad National Recreation Area with no locational restrictions. Numbers of personal watercraft using the reservoir and adjoining waters during a high-use day would increase from an average of 32 per day in 2002 to 37 per day in 2012, an average increase of 1.5% per year. It is assumed that 14 personal watercraft would operate in the Amistad Reservoir and Rio Grande upstream of the reservoir in 2002, increasing to 16 by 2012; and 18 personal watercraft would operate in Devils River and San Pedro Canyon, increasing to 21 by 2012 (see Table 20). Table 21 shows the threshold volumes of waters that would be needed to dilute pollutants emitted from personal watercraft under this alternative.

TABLE 21: THRESHOLD WATER VOLUMES NEEDED TO DILUTE PWC EMISSIONS, ALTERNATIVE A

	Amistad Reservoir and Rio Grande — Area 1		Devils River and San Pedro Canyon — Area 2	
	2002	2012	2002	2012
NPS waters open to PWC use (ac-ft)	543,600		124,400	
NPS jurisdictional waters (ac-ft)	543,600		124,400	
Ecotoxicological Benchmarks*				
Benzo(a)pyrene (fuel and exhaust)	77	44	100	58
Naphthalene	31	18	39	23
1-methyl naphthalene	87	50	110	65
Benzene	73	42	94	55
Human Health Benchmarks**				
Benzo(a)pyrene (fuel and exhaust)	250	140	320	180
Benzene	7,900	4,500	10,000	6,000

* Threshold volumes (ac-ft) below which ecotoxicological effects might occur.

** Threshold volumes (ac-ft) below which human health might be impacted.

The 2002 and 2012 calculated threshold volumes to meet ecotoxicological benchmarks range from 18 to 110 acre-feet. These volumes are extremely small in relation to the volumes of water available in each area (543,650 ac-ft in area 1, 124,350 ac-ft in area 2). This indicates that these pollutant loads would be well below the ecotoxicological benchmarks, and there would be a negligible adverse impacts in both areas in 2002 and in 2012.

Similarly, none of the pollutant levels would exceed the human health criteria for the ingestion of water and fish. Threshold volumes range from 140 to 10,000 acre-feet, which are substantially smaller than the water volumes available. Therefore, personal watercraft would have a negligible adverse impact on human health. Pollutant loads in 2012 would be lower than in 2002 because of the overall minimum 50% reduction in engine emissions as estimated by the U.S. Environmental Protection Agency (1997).

A thermocline may become established in the reservoir during the summer. However, as described under the "Methodology and Assumptions," even with a thermocline in the reservoir, the available mixing zone volume would be more than half the total volume in the reservoir, or 271,800 acre-feet, and impacts from PWC use would still be negligible.

Cumulative Impacts. In addition to the personal watercraft that use Amistad National Recreation Area, other two-stroke outboard motorboats would contribute pollutants to the water. As shown in Table 20, the number of motorboats using the reservoir and adjoining waters during a high-use day is projected to increase from 175 per day in 2002 to 213 by 2012; two-thirds of these boats would operate in the Amistad Reservoir and Rio Grande upstream of the reservoir (area 1), and one-third in the Devils River and San Pedro Canyon (area 2). As described above, total numbers of personal

watercraft are projected to increase from 32 in 2002 to 37 in 2012. Water volumes needed to dilute PWC and motorboat emissions are shown in Table 22.

TABLE 22: THRESHOLD WATER VOLUMES NEEDED TO DILUTE PWC AND MOTORIZED BOAT EMISSIONS, ALTERNATIVE A

	Amistad Reservoir and Rio Grande — Area 1		Devils River and San Pedro Canyon — Area 2	
	2002	2012	2002	2012
NPS waters open to motorboat use (ac-ft)	543,600		124,400	
NPS jurisdictional waters (ac-ft)	543,600		124,400	
Ecotoxicological Benchmarks*				
Benzo(a)pyrene (fuel and exhaust)	710	430	430	260
Naphthalene	280	170	170	100
1-methyl naphthalene	800	490	490	290
Benzene	680	410	410	250
Human Health Benchmarks**				
Benzo(a)pyrene (fuel and exhaust)	2,300	1,400	1,400	830
Benzene	73,000	44,000	44,000	27,000

* Threshold volumes (ac-ft) below which ecotoxicological effects might occur.

** Threshold volumes (ac-ft) below which human health might be impacted.

The calculated threshold volumes for pollutants emitted in 2002 by personal watercraft and other motorboats would be substantially greater than the threshold volumes due to PWC use alone. The volumes would range from 170 to 800 acre-feet for the ecotoxicological benchmarks. By 2012 ecotoxicological threshold volumes would decrease to a range of 100 to 490 acre-feet, despite an increase in the numbers of all motorized watercraft. Concentrations of all the organic contaminants evaluated would be well below the water quality benchmarks and would likely not be detectable. Cumulative ecological impacts would be negligible.

Based on the human health benchmarks, the calculated threshold volumes for pollutants emitted by personal watercraft and boats in 2002 would range from 1,400 to 73,000 acre-feet and would decrease by 2012 to a range of 830 to 44,000 acre-feet, despite an increase in the numbers of person watercraft and other motorboats. Concentrations of all the organic contaminants evaluated would be well below the water quality benchmarks for ingestion of water and fish and likely would not be detectable. Cumulative impacts to human health would be negligible.

As described for PWC use alone, even with a thermocline in the reservoir, the available mixing zone volume would be more than half the total volume in the reservoir, or 271,800 acre-feet, and impacts from PWC use and other motorboats would still be negligible.

Conclusion. Continuing PWC use under a special regulation would have negligible adverse effects on water quality. All pollutant loads would be well below ecotoxicological benchmarks and human health criteria.

Cumulative impacts from PWC and motorized boat use would also be negligible. By 2012, any impacts would be reduced substantially through improved emission controls.

This alternative would not result in an impairment of the water quality resource.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. PWC use would continue within the reservoir but would be banned from the Pecos River, the Rio Grande north of buoy 28, the Devils River north of buoy P, and San Pedro Canyon east of buoy SPC-1 — the area defined as area 2. Overall numbers of personal watercraft are projected to remain the same as in alternative A, except they would all be concentrated in the main reservoir and the Rio Grande downstream of buoy 28 and the Devils River downstream of buoy P (area 1). Maximum use is projected to increase from an average of 32 per day in 2002 to 37 per day by 2012. Threshold volumes of water needed to dilute pollutants are shown in Table 23.

TABLE 23: THRESHOLD WATER VOLUMES NEEDED TO DILUTE PWC EMISSIONS, ALTERNATIVE B

	Amistad Reservoir and Rio Grande — Area 1		Devils River and San Pedro Canyon* — Area 2	
	2002	2012	2002	2012
NPS waters open to PWC use (ac-ft)	331,800		0	
NPS jurisdictional waters (ac-ft)	543,600		124,400	
Ecotoxicological Benchmarks**				
Benzo(a)pyrene (fuel and exhaust)	180	100	--	--
Naphthalene	70	40	--	--
1-methyl naphthalene	200	120	--	--
Benzene	170	100	--	--
Human Health Benchmarks***				
Benzo(a)pyrene (fuel and exhaust)	560	330	--	--
Benzene	18,000	10,000	--	--

* Personal watercraft would not be allowed to operate in Devils River or San Pedro Canyon under alternative B.
** Threshold volumes (ac-ft) below which ecotoxicological effects might occur.
*** Threshold volumes (ac-ft) below which human health might be impacted.

The 2002 and 2012 calculated threshold volumes to meet ecotoxicological benchmarks range would from 40 to 200 acre-feet in area 1. These thresholds volumes are extremely small when compared to the volume of water available to personal watercraft (331,800 ac-ft). Pollutant loads would be well below the ecotoxicological benchmarks, and there would be a negligible adverse impact. Similarly, the threshold volumes for human health impacts would range from 330 to 18,000 acre-feet, again well below the volume of water available, and there would be negligible adverse impact on water quality. Because PWC use would not be allowed in the Devils River and Sand Pedro Canyon areas, impacts on water quality in this area would be beneficial.

If a thermocline reduced the available water volume in Amistad Reservoir to somewhat more than half (271,800 ac-ft), the highest threshold volume (18,000 ac-ft for benzene) would still be substantially less than the available volume. Impacts from PWC use would still be negligible.

Cumulative Impacts. As described for alternative A, other two-stroke outboard motorboats would contribute pollutants to the water. The number of motorboats using the reservoir and adjoining waters during a high-use day is projected to increase from 175 per day in 2002 to 213 per day in 2012 (an increase of 2% per year). Of these motorboats, 115 would be in area 1 in 2002, increasing to 140 by 2012, and 60 would be in area 2, increasing to 73 by 2012 (see Table 20). As described above, the total number of personal watercraft is projected to increase from 32 per day in 2002 to 37 per day by 2012; however, they would only be allowed to operate in area 1. Projected water volumes need to dilute emitted pollutants are shown in Table 24.

TABLE 24: THRESHOLD WATER VOLUMES NEEDED TO DILUTE PWC AND MOTORIZED BOAT EMISSIONS, ALTERNATIVE B

	Amistad Reservoir and Rio Grande — Area 1		Devils River and San Pedro Canyon* — Area 2	
	2002	2012	2002	2012
NPS waters open to PWC use (ac-ft)	331,800		0	
NPS jurisdictional waters (ac-ft)	543,600		124,400	
Ecotoxicological Benchmarks**				
Benzo(a)pyrene (fuel and exhaust)	810	490	330	200
Naphthalene	320	190	130	80
1-methyl naphthalene	920	550	370	230
Benzene	770	460	310	190
Human Health Benchmarks***				
Benzo(a)pyrene (fuel and exhaust)	2,600	1,600	1,100	640
Benzene	83,000	50,000	34,000	21,000

* Personal watercraft not allowed to operate in Devils River or San Pedro Canyon
** Threshold volumes (ac-ft) below which ecotoxicological effects might occur.
*** Threshold volumes (ac-ft) below which human health might be impacted.

The 2002 and 2012 calculated threshold volumes needed to dilute PWC and motorboat emissions based on ecotoxicological benchmarks would range from 190 to 920 acre-feet in area 1 and from 80 to 370 acre-feet in area 2, which would only reflect threshold volumes for emissions from other motorboats. These volumes are extremely small in relation to the volumes of water available in the two areas, indicating that these pollutant loads would be well below the benchmarks, and there would be a negligible adverse impact.

Similarly, the 2002 and 2012 threshold volumes for human health impacts would range from 640 to 83,000 acre-feet, substantially less than the available volumes in areas 1 and 2. There would be negligible adverse impacts on water quality based on human health benchmarks.

If a thermocline reduced the available water volume in Amistad Reservoir to somewhat more than half (271,800 ac-ft), the highest threshold volume (83,000 ac-ft for benzene) would still be substantially less than the available volume. Impacts from all motorized watercraft use in area 1 would still be negligible.

Conclusion. Alternative B would have negligible adverse effects on water quality based on both ecotoxicological and human health benchmarks in both 2002 and 2012. Because PWC use would not be allowed in the Devils River and Sand Pedro Canyon areas, impacts on water quality in these areas would be beneficial.

Cumulative impacts from PWC and motorboat use also would be negligible. By 2012, any impacts would be reduced substantially through improved emission controls.

This alternative would not result in an impairment of the water quality resource.

Impacts of the No-Action Alternative — No PWC Use

Analysis. No PWC use would be allowed within Amistad National Recreation Area after November 6, 2002. Therefore, personal watercraft would not contribute pollutants to reservoir waters. The no-action alternative would have a beneficial impact on water quality at Amistad National Recreation Area.

Cumulative Impacts. Cumulative emissions in both areas 1 and 2 would be less than under alternative A or B because of the elimination of PWC use. Boating activity would continue and would be the

same as described under the previous alternatives, increasing from an estimated 175 boats in 2002 to 213 boats in 2012. Threshold volumes needed to dilute motorboat emission are shown in Table 25.

TABLE 25: THRESHOLD WATER VOLUMES NEEDED TO DILUTE MOTORIZED BOAT EMISSIONS, NO-ACTION ALTERNATIVE

	Amistad Reservoir and Rio Grande — Area 1		Devils River and San Pedro Canyon — Area 2	
	2002	2012	2002	2012
NPS waters open to PWC use (ac-ft)	0		0	
NPS jurisdictional waters (ac-ft)	543,650		124,400	
Ecotoxicological Benchmarks*				
Benzo(a)pyrene (fuel and exhaust)	640	390	330	200
Naphthalene	250	150	130	80
1-methyl naphthalene	720	440	370	230
Benzene	600	370	310	190
Human Health Benchmarks**				
Benzo(a)pyrene (fuel and exhaust)	2,000	1,200	1,100	640
Benzene	65,000	40,000	34,000	21,000

* Threshold volumes (ac-ft) below which ecotoxicological effects might occur.
** Threshold volumes (ac-ft) below which human health might be impacted.

Emissions from motorboats other than personal watercraft would have a negligible adverse impact on water quality. Predicted threshold volumes for all pollutants in both areas in 2002 and 2012 would all be substantially lower than the jurisdictional water volumes available. In the main reservoir and the Rio Grande, where 543,600 acre-feet are available, threshold volumes would range from 250 to 65,000 acre-feet in 2002. In the Devils River and San Pedro Canyon, with 124,400 acre-feet available, threshold volumes would be 130 to 34,000 acre-feet in 2002. These low threshold volumes would decrease further by 2012 because of improvements in motorboat engine technology.

If the available water volume in Amistad Reservoir was reduced to somewhat more than half due to a thermocline, the highest threshold volume would still be less than the available volume, and impacts from other motorboats would still be negligible.

Conclusion. Discontinuing PWC operations would have a beneficial impact on water quality.

While pollutant emissions from personal watercraft would be eliminated, emissions from other motorized craft would continue. Overall, the cumulative impacts from motorboats would be negligible.

This alternative would not result in an impairment of the water resource.

AIR QUALITY

Personal watercraft emit various compounds that pollute the air. In the two-stroke engines commonly used in personal watercraft, the lubricating oil is used once and is expelled as part of the exhaust; and the combustion process results in emissions of air pollutants such as volatile organic compounds (VOC), nitrogen oxides (NO_x), particulate matter (PM), and carbon monoxide (CO). Personal watercraft also emit fuel components such as benzene that are known to cause adverse health effects. Even though PWC engine exhaust is usually routed below the waterline, a portion of the exhaust gases go into the air. These air pollutants may adversely impact park visitor and employee health, as well as sensitive park resources. For example, in the presence of sunlight VOC and NO_x emissions combine to form ozone. Ozone causes respiratory problems in humans, including cough, airway irritation, and

chest pain during inhalations (US EPA 1996c). Ozone is also toxic to sensitive species of vegetation. It causes visible foliar injury, decreases plant growth, and increases plant susceptibility to insects and disease (US EPA 1996c). Carbon monoxide can affect humans as well. It interferes with the oxygen carrying capacity of blood, resulting in lack of oxygen to tissues. NO_x and PM emissions associated with PWC use can also degrade visibility (CARB 1997; US EPA 2000). NO_x can also contribute to acid deposition effects on plants, water, and soil. However, because emission estimates show that NO_x from personal watercraft are minimal (less than 5 tons per year), acid deposition effects attributable to personal watercraft use are expected to be minimal.

GUIDING REGULATIONS AND POLICIES

Clean Air Act. The Clean Air Act establishes national ambient air quality standards (NAAQS) to protect the public health and welfare from air pollution. The act also established the prevention of significant deterioration of air quality program to protect the air in relatively clean areas. One purpose of this program is to preserve, protect, and enhance air quality in areas of special national or regional natural, recreational, scenic, or historic value (42 USC 7401 et seq.). The program also includes a classification approach for controlling air pollution.

Amistad National Recreation Area is a class II area, and the Clean Air Act allows only moderate air quality deterioration in these areas. In no case, however, may pollution concentrations violate any of the national ambient air quality standards. In contrast, class I areas are afforded the greatest degree of air quality protection. Very little deterioration of air quality is allowed in these areas, and the unit manager has an affirmative responsibility to protect visibility and all other class I area air quality related values from the adverse effects of air pollution. The nearest class I area to Amistad is Big Bend National Park, approximately 140 miles west.

Conformity Requirements. National park system areas that do not meet the national ambient air quality standards or whose resources are already being adversely affected by current ambient levels require a greater degree of consideration and scrutiny by NPS managers. Areas that do not meet national air quality standards for any pollutant are designated as nonattainment areas. Section 176 of the Clean Air Act states:

> No department, agency, or instrumentality of the Federal Government shall engage in, support in any way or provide financial assistance for, license or permit, or approve, any activity which does not conform to an implementation plan [of the state]. . . . [T]he assurance of conformity to such a plan shall be an affirmative responsibility of the head of such department, agency or instrumentality.

Essentially, federal agencies must ensure that any action taken does not interfere with a state's plan to attain and maintain the national ambient air quality standards in designated nonattainment and maintenance areas.

Amistad National Recreation Area is an attainment area for all criteria pollutants and is not subject to a maintenance plan, so the conformity requirements do not apply to this unit.

Applicable PWC Emission Standards. The Environmental Protection Agency issued the gasoline marine engine final rule in August 1996. The rule, which took effect in 1999, affects manufacturers of new outboard engines and the type of inboard engines used in personal watercraft. The agency adopted a phased approach to reduce emissions. The current emission standards were set at levels that are achievable by existing personal watercraft. By 2006 PWC manufacturers will be required to meet a corporate average emission standard that is equivalent to a 75% reduction in VOC emissions. (The

corporate average standard allows manufacturers to build some engines to emission levels lower than the standard and some engines to emission levels higher than the standard, and to employ a mix of technology types, as long as the overall corporate average is at or below the standard.) Because the actual reduction in emissions is dependent on the sale of lower-emitting personal watercraft, the Environmental Protection Agency estimates that a 52% emission reduction will be achieved by 2011 and a 75% emission reduction achieved by 2031 (US EPA 1996a, 1997).

In July 2002 the Environmental Protection Agency proposed new evaporative emissions standards for gasoline-fueled boats and personal watercraft. These proposed standards would require most new boats produced in 2008 or later to be equipped with low-emission fuel tanks or other evaporative emission controls.

NPS Organic Act and Management Policies. The NPS Organic Act of 1916 (16 USC 1 et seq.) and the NPS *Management Policies* guide the protection of park and wilderness areas. The general mandates of the Organic Act state that the National Park Service will

> promote and regulate the use of . . . national parks . . . by such means and measures as conform to the fundamental purpose of the said parks, . . . which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations (16 USC 1).

Under its *Management Policies 2001* the National Park Service will

> seek to perpetuate the best possible air quality in parks to (1) preserve natural resources and systems; (2) preserve cultural resources; and (3) sustain visitor enjoyment, human health, and scenic vistas (sec. 4.7.1).

The *Management Policies* further state that the National Park Service will assume an aggressive role in promoting and pursuing measures to protect air quality related values from the adverse impacts of air pollution. In cases of doubt as to the impacts of existing or potential air pollution on park resources, the National Park Service "will err on the side of protecting air quality and related values for future generations."

The Organic Act and the *Management Policies* apply equally to all areas of the national park system, regardless of Clean Air Act designations. Therefore, the National Park Service will protect resources at both class I and class II designated units. Furthermore, the NPS Organic Act and *Management Policies* provide additional protection beyond that afforded by the Clean Air Act's national ambient air quality standards alone because the National Park Service has documented that specific park air quality related values can be adversely affected at levels below the national standards or by pollutants for which no standard exists.

METHODOLOGY AND ASSUMPTIONS

To assess the level of PWC air quality impacts resulting from a given management alternative, the following methods and assumptions were used:

1. The national ambient air quality standards and state/local air quality standards (if applicable) were examined for each pollutant (the standards are included on page 47).
2. Air quality designations for the surrounding area were determined. Amistad is an attainment area for each criteria pollutant.

3. The nearest monitoring location to Amistad is in Laredo, approximately 150 miles to the south-southeast. Therefore, the first highest maximum concentration for each pollutant is assumed to be below the national ambient air quality standards at Amistad.
4. Typical use patterns of motorized watercraft use were identified (see the "PWC Use Trends" section). Peak hours of use were estimated assuming that on a high-use day all personal watercraft would operate at the same time, and each personal watercraft would be operated for an average of four hours per day.
5. The rated horsepower, average engine load, deterioration factors, and other relevant parameters for each watercraft type were taken from default assumptions in the EPA Nonroad model. (This model is used to calculate emissions of criteria pollutants from the operation of nonroad spark-ignition type engines, including personal watercraft. The model allows assumptions to be made regarding the mix of engine types that will be phased in as new engine standards come into effect, and increasing numbers of personal watercraft will be of the cleaner-burning four-stroke type. Total hydrocarbon emissions comprise approximately 100% of the VOC for two-stroke engines and 93% of the VOC for four-stroke engines [US EPA 1997; US EPA 2000].)
6. Any reductions in emissions resulting from implementing control strategies were taken into account, as were changes in emissions resulting from increased or decreased usage.
7. No studies regarding ozone injury on sensitive plants in the national recreation area were identified; therefore, it is assumed that no injuries are present.
8. A calculation referred to as SUM06 (ppm-hours) was used for ozone. The highest three-month, five-year average commonly used for the area was determined by reviewing ambient air quality data (available from the NPS Air Resources Division).
9. Visibility impairment was determined from local monitoring data, including the Interagency Monitoring of Protected Visual Environments (IMPROVE) network, or from qualitative evidence such as personal observations and photographs, and from estimated emissions of fine particulate matter ($PM_{2.5}$).
10. The air quality impacts of the various alternatives were assessed by considering the existing air quality levels and the air quality related values present, and by using the estimated emissions and any applicable, and EPA-approved air emissions estimation methods (Nonroad model version 1998). Estimated reductions in hydrocarbon emissions are derived from EPA's mandated technology improvements applicable to PWC engine manufacturers.
11. For cumulative impacts, the assessment was completed quantitatively with respect to anticipated use of the national recreation area by other recreational watercraft based on emission factors and assumptions in the EPA Nonroad model. Types of craft assessed for quantitative cumulative impacts included vessels with predominantly outboard spark-ignition type engines. For Amistad, it was assumed that the majority of vessels are outboard with predominantly two-stroke engines. This is a conservative approach, as outboard engines usually emit more pollutants per unit of time operated in comparison to inboards. Other sources of air pollutants in the area were also considered in the cumulative analysis through a review of the state implementation plan, county records, and the use of best professional judgment.

PWC impact thresholds for air quality are dependent on the type of pollutants produced, the background air quality, and the pollution-sensitive resources (air quality related values) present. Impact thresholds may be qualitative (e.g., photos of degraded visibility, which are primarily judgmental) or

quantitative (e.g., based on quantities of pollutants emitted relative to a threshold or ambient values relative to a standard), depending on what type of information is appropriate or available.

PWC impact thresholds for air quality depend on the type of pollutants produced, the background air quality, and the resources in the environmental that may be affected by airborne pollutants (air quality related values). Air quality related values include "visibility and those scenic, cultural, biological, and recreation resources of an area that are affected by air quality" (43 FR 15016).

Impact thresholds may be qualitative, such as photos of degraded visibility, or quantitative, based on impacts on air quality related values or federal air quality standards, or emissions based on emission factor models. The type of thresholds used in an analysis depends on what type of information is appropriate or available. Because the U.S. Environmental Protection Agency has established standards that are regulated by states to protect human health and the environment, two categories of potential airborne pollution impacts from personal watercraft are analyzed: impacts on human health resources, and impacts on air quality related values in the study area. Thresholds for each impact category are discussed separately.

IMPACT ANALYSIS AREA

The impact analysis area includes the reservoir at and below the elevation of 1,117 feet above mean sea level. The unit extends 74 miles northwest up the Rio Grande, 25 miles north up the Devils River, and 14 miles north up the Pecos River. It is assumed that air pollutants would dissipate beyond the study area boundary due to airflow and dispersion; therefore, both local and regional effects are considered in the analysis.

IMPACT TO HUMAN HEALTH FROM AIRBORNE POLLUTANTS RELATED TO PWC USE

The following impact thresholds for an attainment area have been defined for analyzing impacts to human health from airborne pollutants — CO, PM_{10}, total hydrocarbons (THC), and nitrogen oxides (NO_x). Almost all THC are also volatile organic compounds (VOC). Sulfur oxides (SO_x) are not included because they are emitted by PWC in very small quantities.

	Activity Analyzed		Current Air Quality
Negligible:	Emissions would be less than 50 tons/year for each pollutant.	**and**	The first highest three-year maximum for each pollutant is less than NAAQS.
Minor:	Emissions would be less than 100 tons/year for each pollutant.	**and**	The first highest three-year maximum for each pollutant is less than NAAQS.
Moderate:	Emissions would be greater than or equal to 100 tons/year for any pollutant.	**or**	The first highest three-year maximum for each pollutant is greater than NAAQS.
Major:	Emissions levels would be greater than or equal to 250 tons/year for any pollutant.	**and**	The first highest three-year maximum for each pollutant is greater than NAAQS.

Impairment: Impacts would have a major adverse effect on park resources and values, and would

contribute to deterioration of the park's air quality to the extent the park's purpose could not be fulfilled as established in its enabling legislation;

affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or

affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

Both VOC and NO_x are ozone precursors in the presence of sunlight and are evaluated separately in lieu of ozone, which is formed as a secondary pollutant. (Note that in attainment areas the Clean Air Act does not require that NO_x be counted as an ozone precursor). Emissions of total hydrocarbons are shown because they are the target pollutant of the EPA regulations; however, they are not a criteria pollutant, so no impact threshold has been assigned.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. PWC use would be continued under a special regulation and would be managed consistent with the management strategies in effect before November 6, 2002. PWC users could travel wherever motorized vessels are authorized. The number of personal watercraft using Amistad is predicted to increase annually by approximately 1.5%, based on current trends at the unit (see Table 20). Baseline data for the 2001/2002 season at Amistad indicate annual use at approximately 640 personal watercraft (Garetz 2002b), with each machine assumed to operate on the water for an average of four hours per day. The predominantly two-stroke engine technology would be replaced gradually over time in accordance with the EPA's requirements for engine manufacturers so that by 2012 most personal watercraft will be the cleaner burning four-stroke type. The impacts of continued PWC use within the unit are presented in Table 26.

TABLE 26: PWC EMISSIONS AND HUMAN HEALTH IMPACT LEVELS, ALTERNATIVE A

	CO		PM_{10}		HC		VOC		NO_x	
	2002	2012	2002	2012	2002	2012	2002	2012	2002	2012
Annual Emissions (tons/year)	14.33	13.45	0.29	0.06	7.46	3.02	7.72	2.82	0.07	0.24
Impact Level	Negligible	Negligible	Negligible	Negligible	Information only	Information only	Negligible	Negligible	Negligible	Negligible

Emissions and impact levels in 2002 would be negligible adverse for all pollutants since all emissions would be less than 50 tons/year, and no national ambient air quality standards are predicted to be exceeded.

For 2012 emissions would show an overall decrease even taking into consideration the assumed annual activity increase of 1.5%. However, NO_x would show a small increase due to the phase-in of four-stroke engines. The 2012 impact levels would also be negligible.

Cumulative Impacts. Motorboats with predominantly outboard engines are the only other major source of air pollutants within the national recreation area. These watercraft are far more abundant within the reservoir than are personal watercraft, with annual use at 10,726 primarily gasoline powered boats, based on data from Amistad for the 2001/2002 baseline year (Garetz 2002b). This number is

anticipated to increase by 2% per year through 2012 (see Table 20). The cumulative emissions from personal watercraft and other boats are provided in Table 27.

TABLE 27: PWC AND MOTORIZED BOAT EMISSIONS AND HUMAN HEALTH IMPACT LEVELS, ALTERNATIVE A

	CO		PM_{10}		HC		VOC		NO_x	
	2002	2012	2002	2012	2002	2012	2002	2012	2002	2012
Annual Emissions (tons/year)	137.17	170.48	2.79	3.38	34.35	22.55	35.31	22.85	2.02	3.20
Impact Level	Moderate	Moderate	Negligible	Negligible	Informa-tion only	Informa-tion only	Negligible	Negligible	Negligible	Negligible

Overall, cumulative impact levels for PM_{10}, HC, VOC, and NO_x would be negligible, while levels for CO would be moderate in 2002 and 2012. Future emissions of all pollutants would increase slightly due to the predicted overall increase in use of the reservoir by all motorized watercraft (including personal watercraft). Due to the remoteness of the location from industrial and commercial development, no measurable effects from other sources of air pollution are anticipated. Proposed regulations directed at engine manufacturers to reduce emissions of pollutants from motorized boats may reduce the cumulative impacts from this source over time.

Conclusion. Continuing PWC use at Amistad National Recreation Area at existing levels would result in negligible adverse impacts for all pollutants.

Cumulative emission levels would be negligible for PM_{10}, HC, VOC, and NO_x. Cumulative CO emissions would be at a moderate adverse level for both the short and long term. Over the long term NO_x emissions would increase slightly, with a negligible adverse effect. This alternative would not alter existing air quality conditions, with future reductions anticipated in PM_{10}, HC, and VOC emissions due to improved emission controls.

This alternative would not result in an impairment of air quality.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. PWC use would continue under a special regulation that would restrict PWC use in certain areas of the national recreation area, in addition to restrictions under alternative A. Under this alternative the number of personal watercraft visiting Amistad daily is assumed not to change, although locational restrictions would reduce the use area. Annual predicted emissions levels and impacts of continued PWC use within the unit would be the same as those described for alternative A. All impact levels would be negligible, since the emissions would all be less than 50 tons/year.

Cumulative Impacts. Cumulative impacts would be the same as for alternative A, since overall boating use levels would not change under this alternative. Cumulative emission levels would be negligible for PM_{10}, HC, VOC, and NO_x. Cumulative CO emissions would be at a moderate adverse level for the short and long term. This alternative would maintain existing air quality conditions, with future reductions in PM_{10}, HC, and VOC emissions predicted due to improved emission controls.

Conclusion. Continuing PWC use at Amistad would result in negligible adverse impacts for all pollutants from PWC emissions.

Similar to alternative A, cumulative emission levels from all boats and personal watercraft would be negligible for PM_{10}, HC, VOC, and NO_x, and moderate for CO in the short and long term. Over the long term NO_x emissions would increase slightly, with a negligible adverse effect. This alternative would maintain existing air quality conditions, with future reductions in PM_{10}, HC, and VOC emissions.

This alternative would not result in an impairment of air quality.

Impacts of the No-Action Alternative — No PWC Use

Analysis. Under the no-action alternative, PWC use at Amistad National Recreation Area would be prohibited after November 6, 2002. There would be no further PWC emissions of CO, PM_{10}, HC, VOC, and NO_x within the unit boundary, resulting in long-term, beneficial impacts.

Cumulative Impacts. PWC contribution to overall cumulative emissions would be eliminated. Cumulative emissions for all other watercraft would remain moderate for CO and negligible for all other pollutants throughout the assessment period, with no contribution to emissions from PWC use (see Table 28). Emissions in 2012 are predicted to be slightly greater than 2002 due to the predicted increase in boat numbers.

TABLE 28: MOTORIZED BOAT EMISSIONS AND HUMAN HEALTH IMPACT LEVELS, NO-ACTION ALTERNATIVE

	CO		PM_{10}		HC		VOC		NO_x	
	2002	2012	2002	2012	2002	2012	2002	2012	2002	2012
Annual Emissions (tons/year)	122.84	157.10	2.50	3.31	26.89	19.33	27.59	19.84	1.95	2.97
Impact Level	Moderate	Moderate	Negligible	Negligible	Informa-tion only	Informa-tion only	Negligible	Negligible	Negligible	Negligible

Conclusion. The no-action alternative would have beneficial impacts on air quality because PWC use would be banned within the reservoir, resulting in no PWC-related air emissions.

PWC contribution to cumulative air quality impacts would be eliminated, with associated reductions in emissions. Cumulative impacts from other boats would remain moderate for CO and negligible for the other pollutants analyzed for both 2002 and 2012. With improved emission controls directed at motorized watercraft, future emission rates of most pollutants would gradually decline.

The no-action alternative would not impair air quality.

IMPACT TO AIR QUALITY RELATED VALUES FROM PWC POLLUTANTS

The following impact thresholds have been defined for analyzing impacts to air quality related values, which include visibility and biological resources (specifically ozone effects on plants) from airborne pollutants related to PWC use (O_3, NO_x, $PM_{2.5}$). To assess the impact of ozone on plants, the five-year ozone index value was calculated and is represented as SUM06. National SUM06 values have been developed by the NPS Air Resources Division based on rural and urban monitoring sites. Based on the five-year average data provided by National Park Service, the SUM06 for the impact analysis area is within a range of 12–19 ppm-hrs based on rural site data. $PM_{2.5}$ as a fraction of particulate matter is evaluated for visibility impairment.

The following PWC impact levels for air quality related values are assumed:

	Activity Analyzed		Current Air Quality
Negligible:	Emissions would be less than 50 tons/year for each pollutant.	**and**	There are no perceptible visibility impacts (photos or anecdotal evidence). **and** There is no observed ozone injury on plants. **and** SUM06 ozone is less than 12 ppm-hours.
Minor:	Emissions would be less than 100 tons/year for each pollutant.	**and**	SUM06 ozone is less than 15 ppm-hours.
Moderate:	Emissions would be greater than 100 tons/year for any pollutant. **or** Visibility impacts from cumulative PWC emissions would be likely (based on past visual observations).	**or**	Ozone injury symptoms are identifiable on plants. **and** SUM06 ozone is less than 25 ppm-hours.
Major:	Emissions would be equal to or greater than 250 tons/year for any pollutant. **or** Visibility impacts from cumulative PWC emissions would be likely (based on modeling or monitoring).	**and**	Ozone injury symptoms are identifiable on plants. **or** SUM06 ozone is greater than 25 ppm-hours.

Impairment: Air quality related values in the park would be adversely affected. In addition, impacts would

have a major adverse effect on park resources and values; and

contribute to deterioration of the park's air quality to the extent that the park's purpose could not be fulfilled as established in its enabling legislation; or

affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or

affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. Table 29 presents the annual PWC emission loads and their impact levels for 2002 and 2012 under this alternative. The current air quality based on SUM06 ozone values for rural sites is in the range of approximately 12 ppm-hour and less than 19 ppm-hour. No adverse effects to plants from ozone exposure have been identified at Amistad. For visibility, $PM_{2.5}$ emissions are used to assess impact levels. Currently, there are no perceptible qualitative visibility impacts at Amistad, and emissions of fine particulate matter are very low (less than one ton per year). Overall, PWC impact

levels under this alternative would be negligible, considering the combined impacts to air quality related values.

TABLE 29: AIR QUALITY RELATED IMPACTS FROM PWC EMISSIONS, ALTERNATIVE A

Air Quality Related Value (indicator)	Emission Level (tons/year)/ Local Ozone Data		Visibility Threshold / SUM06 Index Value		Impact Level	
	2002	2012	2002	2012	2002	2012
Visibility ($PM_{2.5}$)	0.27	0.06	No perceptible visibility impacts	No perceptible visibility impacts	Negligible	Negligible
Ozone injury to plants (injury symptoms and ozone monitoring data)	No park specific effects documented	Unknown, but not anticipated	SUM06 index value: 12–19 ppm-hrs (rural monitoring sites for year 2000)	SUM06 index value: less than or equal to 12–19 ppm-hrs (assumed to be no greater than year 2002)	Minor (see analysis)	Minor (see analysis)

SOURCE: NPS Air Resources Division for SUM06 values.

Cumulative Impacts. The cumulative impact analysis includes all other marine vehicle use, taking into consideration national use trends, as well as current and future emission levels. Effects on visibility, wildlife, and plants due to airborne pollutants were considered. Cumulative emissions and impacts of all PWC and other boating activities under alternative A are shown in Table 30.

The cumulative ozone exposure effects under this alternative are not expected to result in foliar injury to plants and would be negligible adverse for both 2002 and 2012. Visibility impact levels would be negligible. Overall cumulative impacts to air quality related values would be negligible considering the combination of sources affecting air quality related values.

TABLE 30: AIR QUALITY RELATED IMPACTS FROM PWC EMISSIONS AND MOTORIZED BOATS, ALTERNATIVE A

Air Quality Related Value (indicator)	Emission Level (tons/year)/ Local Ozone Data		Visibility Threshold / SUM06 Index Value		Impact Level	
	2002	2012	2002	2012	2002	2012
Visibility ($PM_{2.5}$)	2.57	2.87	No perceptible visibility impacts	No perceptible visibility impacts	Negligible	Negligible
Ozone injury to plants (injury symptoms and ozone monitoring data)	No park specific effects documented	Unknown, but not anticipated	SUM06 index value: 12–19 ppm-hrs (rural monitoring sites for year 2000)	SUM06 index value: less than or equal to 12–19 ppm-hrs (assumed to be no greater than year 2002)	Minor (see analysis)	Minor (see analysis)

SOURCE: NPS Air Resources Division for SUM06 values.

Conclusion. PWC annual emissions under alternative A would result in negligible adverse for ozone exposure for years 2002 and 2012. No adverse effects to plants from ozone exposure have been identified at Amistad. There would be negligible impact levels to visibility as $PM_{2.5}$ emissions would be below 50 tons/year for both years 2002 and 2012. Currently, there are no perceptible qualitative visibility impacts at Amistad, and PWC impact levels on visibility under this alternative would be negligible.

The cumulative impacts from all boating activities would result in overall negligible adverse impacts to air quality related values.

This alternative would not result in an impairment of air quality related values.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. PWC use would continue under a special regulation that would restrict the geographic areas where PWC are permitted to operate. Under this alternative the daily number of personal watercraft operating in Amistad would not change from that projected in alternative A (see Table 20). Because certain areas would be closed to PWC use, personal watercraft would be concentrated in a smaller area. The annual predicted emissions levels and impacts of continued PWC use within the unit would be the same as those described for alternative A — minor, adverse impacts for ozone, and negligible, adverse impacts for visibility throughout the assessment period.

Cumulative Impacts. Cumulative emissions and impacts of all motorized watercraft under alternative B would be the same as for alternative A. The overall impact levels from air emissions of ozone and fine particulate matter would be negligible for 2002 and 2012.

Conclusion. PWC emissions under alternative B would result in negligible overall adverse impacts to air quality related values in years 2002 and 2012.

Cumulative impacts from PWC and other marine boating activities would result in negligible adverse air quality related values in both 2002 and 2012.

Implementation of this alternative would not result in an impairment of air quality related values.

Impacts of the No-Action Alternative — No PWC Use

Analysis. Under the no-action alternative PWC use within the unit would be banned, resulting in a beneficial impact on visibility and ozone. Currently, there are no visibility impacts, and no ozone injury has been observed on plants at Amistad.

Cumulative Impacts. While PWC use would no longer be allowed within the unit, other motorized watercraft would continue at the use levels assumed for alternatives A and B. The total cumulative emission loads and impact levels are presented in Table 31. The cumulative ozone impact levels from air emissions of all activities under the no-action alternative for both 2002 and 2012 would be negligible. Visibility impact levels would be negligible. Future emission levels would increase slightly due to the predicted 2% per year increase in boating activity at Amistad. This increase is likely to be offset by EPA regulations directed at curbing emissions from motorized boats.

TABLE 31: AIR QUALITY RELATED IMPACTS FROM MOTORIZED BOATS, NO-ACTION ALTERNATIVE

Air Quality Related Value (indicator)	Emission Level (tons/year)/ Local Ozone Data		Visibility Threshold / SUM06 Index Value		Impact Level	
	2002	2012	2002	2012	2002	2012
Visibility ($PM_{2.5}$)	2.30	2.81	No perceptible visibility impacts	No perceptible visibility impacts	Negligible	Negligible
Ozone injury to plants (injury symptoms and ozone monitoring data)	No park specific effects documented	Unknown, but not anticipated	SUM06 index value: 12–19 ppm-hrs (rural monitoring sites for year 2000)	SUM06 index value: less than or equal to 12–19 ppm-hrs (assumed to be no greater than year 2002)	Minor (see analysis)	Minor (see analysis)

SOURCE: NPS Air Resources Division for SUM06 values.

Conclusion. Implementation of the no-action alternative would have beneficial impacts on visibility and ozone because PWC use would be banned from the unit.

Ozone impacts from airborne pollutants related to all other boating activities would continue to be negligible, but there would be no contribution from PWC use. Visibility impacts would be negligible, and overall impacts to air quality related values would be negligible.

This alternative would not result in an impairment of air quality related values.

SOUNDSCAPES

The primary soundscape issue relative to PWC use is that other visitors may perceive the sound made by personal watercraft as an intrusion or nuisance, thereby disrupting their experiences. This disruption is generally short term because personal watercraft travel along the shore to outlying areas. However, as PWC use increases and concentrates at beach areas, related noise becomes more of an issue, particularly during certain times of the day. Additionally, visitor sensitivity to PWC noise varies from backcountry users (more sensitive) to swimmers at popular beaches (less sensitive). Amistad's backcountry visitors consist of boaters who camp at unofficial campsites along the shoreline.

GUIDING REGULATIONS AND POLICIES

The national park system includes some of the quietest places on earth, as well as a rich variety of sounds intrinsic to park environments. These intrinsic sounds are recognized and valued as a park resource, in keeping with the NPS mission (*Management Policies 2001,* sec. 1.4.6), and are referred to as the park's natural soundscape. The natural soundscape, sometimes called natural quiet, is the aggregate of all the natural sounds that occur in parks, absent human-caused sound, together with the physical capacity for transmitting the natural sounds (*Management Policies 2001,* sec. 4.9). It includes all of the sounds of nature, including such "non-quiet" sounds as birds calling, waterfalls, thunder, and waves breaking against the shore. Some natural sounds are also part of the biological or other physical resource components of parks (e.g., animal communication, sounds produced by wind in trees, thunder or running water).

NPS policy requires the restoration of degraded soundscapes to the natural condition whenever possible, and the protection of natural soundscapes from degradation due to noise (undesirable human-caused sound) (*Management Policies 2001,* sec. 4.9). The National Park Service is specifically directed to "take action to prevent or minimize all noise that, through frequency, magnitude, or duration, adversely affects the natural soundscape or other park resources or values, or that exceeds levels that have been identified as being acceptable to, or appropriate for, visitor uses at the sites being monitored" (*Management Policies 2001,* sec. 4.9). Overriding all of this is the fundamental purpose of the national park system, established in law (16 USC 1 et seq.), which is to conserve park resources and values (*Management Policies 2001*, sec. 1.4.3). NPS managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adverse impacts on park resources and values (*Management Policies 2001,* sec. 1.4.3).

Noise can adversely affect park resources, including but not limited to natural soundscapes. It can directly impact them, for example, by modifying or intruding upon the natural soundscape. It can also indirectly impact resources, for example, by interfering with sounds important for animal communication, navigation, mating, nurturing, predation, and foraging functions.

Noise can also adversely impact park visitor experiences. The term "visitor experience" can be defined as the opportunity for visitors to experience a park's resources and values in a manner appropriate to the park's purpose and significance, and appropriate to the resource protection goals for a specific area or management zone within that park. In other words, visitor experience is primarily a resource-based opportunity appropriate to a given park or area within a park, rather than a visitor-based desire. Noise impacts to visitor experience can be especially adverse when management objectives for visitor experience include solitude, serenity, tranquillity, contemplation, or a completely natural or historical environment. Management objectives (also called desired conditions) for resource protection and visitor experience are derived through well-established public planning processes from law, policy, regulations, and management direction applicable to the entire national park system and to each specific park unit.

Visitor uses of parks will only be allowed if they are appropriate to the purpose for which a park was established, and if they can be sustained without causing unacceptable impacts to park resources or values (*Management Policies 2001,* sec. 8.1 and 8.2). While the fundamental purpose of all parks also includes providing for the "enjoyment" of park resources and values by the people of the United States, enjoyment can only be provided in ways that leave the resources and values unimpaired for the enjoyment of future generations (*Management Policies 2001,* sec. 1.4.3). Unless mandated by statute, the National Park Service will not allow visitors to conduct activities that, among other things, unreasonably interfere with "the atmosphere of peace and tranquillity, or the natural soundscape maintained in wilderness and natural, historic, or commemorative locations within the park" (*Management Policies 2001,* sec. 8.2). While many visitor activities are allowed or even encouraged in parks consistent with the above policies, virtually all visitor activities are limited or restricted in some way (e.g., through carrying-capacity determinations, implementation plans, or visitor use management plans), and on a park- or area-specific basis, some visitor activities are not allowed at all.

The degree to which a given activity (e.g., PWC use) is consistent with, or moves the condition of a resource or a visitor experience toward or away from a desired condition, is one measure of the impact of the activity.

The federal regulation pertaining to noise abatement for boating and water use activities (36 CFR 3.7) prohibits operating a vessel on inland waters "so as to exceed a noise level of 82 decibels measured at a distance of 82 feet (25 meters) from the vessel" and specifies that testing procedures to determine such noise levels should be in accordance with or exceed those established by the Society of Automotive Engineers (SAE) in "Exterior Sound Level Measurement Procedure for Pleasure Motorboats" (J34). This SAE procedure specifies that sound level measurements be taken 25 meters perpendicular to the line of travel of the vessel at full throttle (SAE 2001). It is important to note that this NPS regulation and the SAE procedure were developed for enforcement purposes, not impact assessment purposes. The level in the regulation does not imply that there are no impacts to park resources or visitor experiences at levels below 82 dB; it just indicates that noise levels from vessels legally operating on NPS waters will be no "louder" than 82 dB. As explained elsewhere in this document, a single decibel value does not provide much information for impact assessment purposes.

In addition to NPS policies, Texas has adopted legislation that regulates PWC operation. The following elements of Texas PWC regulations have impacts on national recreation area soundscapes:

- Timing restrictions — Personal watercraft cannot be used between sunset and sunrise.
- Location restrictions — Personal watercraft in Texas cannot operate within 50 feet of another vessel, platform, person, object, or shore except at headway speed without creating a swell or wake.

Natural noise sources at Amistad National Recreation Area include waves of Lake Amistad, winds blowing across water, and bird calls. Automobile noise is very limited, since roads are few and most are southeast of the national recreation area.

METHODOLOGY AND ASSUMPTIONS

The methodology used to assess PWC-related noise impacts in this document is consistent with NPS *Management Policies 2001, Director's Order #47: Soundscape Preservation and Noise Management,* and the methodology being developed for the reference manual for *Director's Order #47* (NPS 2000b). Specific factors at Amistad related to context, time, and intensity are discussed below and are then integrated into a discussion of the impact thresholds used in this analysis.

Context: Existing background noise levels at Amistad National Recreation are influenced by wave action, wind, visitor activities, other boats, hunters, and light automobile traffic. The only time there is continuous noise from boating activity is on busy summer weekends, when the park receives many sightseers and water-skiers. Bass fishing tournaments occur almost every weekend, which also increases visitation. However, even on busy Saturdays, there are many places in the highest use areas where visitors can enjoy occasional periods of quiet and listen to the park's natural quiet (G. Garetz, NPS, pers. comm., P. Steinholtz , URS, Sept. 5, 2002).

Soundscape disturbances in Amistad National Recreation are concentrated in nearshore areas in the southeastern area of the park where people are present at beaches. Texas regulations mandate that PWC operators must travel at such speed as to not cause a swell or wake when 50 feet from the shoreline.

Time Factors: *Time Periods of Interest* — PWC use occurs primarily during mid-day through July and August on weekends, and in evenings after work on weeknights. Use is high in spring and fall, but decreases to almost zero in winter months. State law restricts use to the hours between sunrise and sunset. Use generally stops during periods of inclement weather (e.g., cold and thunderstorms).

Time periods of greater sensitivity to noise impacts include sunset, sunrise, and night time when boaters are in camp and wildlife may be more active.

Duration and Frequency of Occurrence of Noise Impacts — In areas of concentrated PWC use, noise from personal watercraft (and other boat types) can be present intermittently from early morning to sunset. In areas of low use, noise from personal watercraft (and other boat types) can be occasional, usually lasting a few minutes. On peak days, an average of 32 personal watercraft are used for an average of four hours within the reservoir.

Intensity: Some literature states that all recently manufactured watercraft emit fewer than 80 dB at 50 feet from the vessel, while other sources attribute levels as high as 102 dB without specifying distance.

Noise limits established by the National Park Service are 82 dB at 82 feet. PWC noise travels in relationship to the speed of the craft, the distance from shoreline, and other influences. Outdoor noise levels usually decrease with increasing distance from the source because of geometrical spreading of the noise over a bigger surface and absorption of the noise by the atmosphere and the ground (Bruer and Kjaer 2002). According to Komanoff and Shaw (2000), PWC noise dissipates by 5 dBA across water for each doubling of distance from a 20-foot circle around the source and by 6 dBA across land. A PWC engine in the water produces

80 dB of sound within a 20-foot radius, and 73 dB within a 50-foot radius (Komanoff and Shaw 2000). This is close to estimates provided by the Personal Watercraft Industry Association, which state that one PWC operating 50 feet from an on-shore observer is heard at 71 dBA, and two would be heard at 74 dBA (PWIA 2002b).

The National Park Service contracted for noise measurements of personal watercraft and other motorized vessels in 2001 at Glen Canyon National Recreation Area (Harris Miller Miller & Hanson, Inc. 2002). The results show that maximum PWC noise levels at 50 feet ranged from 68 to 76 dBA. Noise levels for other motorboat types measured during that study ranged from 65 to 86 dBA at 50 feet. However, PWC-generated noise may be more disturbing due to rapid changes in acceleration and direction of noise than noise from a constant source at 90 dB (US EPA 1974, cited in Izaak Walton League 1999).

Vegetation can also decrease noise. According to the Federal Highway Administration (2000), vegetation must be so high, wide, and dense that it cannot be seen through, and must be at least 61 meters (186 feet) wide to reduce noise by 10 dB. Amistad has very little shoreline vegetation due to fluctuating lake levels, so vegetation is not an attenuating factor. Some areas of Amistad's shoreline include 200-foot cliffs, which can help attenuate noise. However, many areas do not, and the shoreline consists of land that gradually slopes downward to meet the water. Based on Komanoff and Shaw's more conservative projections, PWC noise levels at Amistad would reach approximately 39 dBA (which is quieter than the sound of bird calls) at 3,200 feet (slightly less than 0.75 mile) from the source of the sound.

In response to public complaints, the PWC industry has employed new technologies to reduce sound by about 50% to 70% on 1999 and newer models (Sea-Doo 2000; Hayes 2002). Additionally, by 2006 the EPA requirements will reduce PWC noise, in association with improvements to engine technology (US EPA 1996b).

Context, time, and intensity together determine the level of impact for an activity. For example, noise for a certain period and intensity would be a greater impact in a highly sensitive context, and a given intensity would result in a greater impact if it occurred more often, or for longer duration. It is usually necessary to evaluate all three factors together to determine the level of noise impact. In some cases an analysis of one or more factors may indicate one impact level, while an analysis of another factor may indicate a different impact level, according to the criteria below. In such cases, best professional judgment based on a documented rationale must be used to determine which impact level best applies to the situation being evaluated.

To estimate the relative impacts of PWC use at Amistad, the following methodology was applied:

1. National literature was used to estimate the average decibel levels of personal watercraft.
2. Areas of shoreline use by other visitors were identified in relation to where PWC users launch and operate offshore. Personal observation from park staff and PWC trailer counts were used to identify these areas, as well as determine the number of personal watercraft and the time of use.
3. Other considerations, such as topography and prevailing winds, were then used to identify areas where PWC noise levels could be exacerbated or minimized.

Sound levels generated by motorized craft using the reservoir area are expected to affect recreational users differently. For example, visitors participating in less sound-intrusive activities such as camping would likely be more adversely affected by PWC noise than another PWC or motorboat user. Therefore, impacts to soundscape must take into account the effect of noise levels on different types of

recreational users within the study area. The following is a list of other considerations for evaluating sound impacts:

- The average maximum number of personal watercraft now operating is 32 per day, which under present trends is expected to increase to 37 by 2012 (based on park estimates of a 1.5% yearly increase). These watercraft are dispersed throughout the reservoir, although they are concentrated in the southeast areas of the park, and they would be in operation for only a portion of each day (approximately four hours average).
- Operations within 50 feet of shore are at no-wake speed; noise levels from this activity are low and for short duration.
- Ambient noise levels at most locations include wind, waves, other visitors, and other motorboats. Other motorboats outnumber personal watercraft by about 5 to 1.

All of these factors combine to lessen the overall impact of noise from PWC use.

IMPACT ANALYSIS AREA

The impact analysis area for soundscapes is the 0.75-mile inland shore area. This is based on a determination that a visitor would have to be approximately 0.75 mile from the shore to experience natural quiet from a PWC user was passing at full throttle outside the 50-foot no-wake zone. In addition, private developments exist along the reservoir, such as Devils Shores and Box Canyon Estates, which are within 0.75 mile of the shore.

IMPACT TO VISITORS FROM NOISE GENERATED BY PERSONAL WATERCRAFT

After estimating the number of personal watercraft, the range of relative noise generated by them, and the potential areas where noise concentrations and effects on other visitors may be of concern, the following thresholds were used as indicators of the magnitude of impact for each of the PWC management alternatives:

Negligible: Natural sounds would prevail; motorized noise would be very infrequent or absent, mostly unmeasurable.

Minor: Natural sounds would predominate in areas where management objectives call for natural processes to predominate, with motorized noise infrequent at low levels. In areas where motorized noise is consistent with park purpose and objectives, motorized noise could be heard frequently throughout the day at moderate levels, or infrequently at higher levels, and natural sounds could be heard occasionally.

Moderate: In areas where management objectives call for natural processes to predominate, natural sounds would predominate, but motorized noise could occasionally be present at low to moderate levels. In areas where motorized noise is consistent with park purpose and objectives, motorized noise would predominate during daylight hours and would not be overly disruptive to noise-sensitive visitor activities in the area; in such areas, natural sounds could still be heard occasionally.

Major: In areas where management objectives call for natural processes to predominate, natural sounds would be impacted by human noise sources frequently or for extended periods of time at moderate intensity levels (but no more than occasionally at high levels), and in a minority of the area. In areas where motorized noise is consistent with park purpose and

zoning, the natural soundscape would be impacted most of the day by motorized noise at low to moderate intensity levels, or more than occasionally at high levels; motorized noise would disrupt conversation for long periods of time and/or make enjoyment of other activities in the area difficult; natural sounds would rarely be heard during the day.

Impairment: The level of noise associated with PWC use would be heard consistently and would be readily perceived by other visitors throughout the day, especially in areas where such noise would potentially conflict with the intended use of that area. In addition, these adverse, major impacts to park resources and values would

contribute to deterioration of the park's soundscape to the extent that the park's purpose could not be fulfilled as established in its enabling legislation;

affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or

affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. As stated in the assumptions, peak daily PWC use levels are projected to range from 32 to 37 during busy summer days over the next 10 years (see Table 20). Under this alternative the major boat/PWC launches would not change. The distribution of personal watercraft during peak summer days under this alternative would range between 16 to 18 at Diablo East, 7 to 8 at Rough Canyon, 5 to 6 at Spur 454, 3 to 4 at South Winds Marina, and 1 to 2 at Box Canyon. According to park staff, PWC users commonly travel singly or in pairs, but also travel in larger groups. PWC use in the northwest section of Amistad along the Rio Grande and the Pecos River is rare.

Texas boating regulations consider 50 feet from the shoreline a no-wake zone. PWC operators traveling at no-wake speeds do not generate substantial noise. At 50 feet from the shoreline one personal watercraft generates less than 75 dB, and two machines generate a total 78 dB (Komanoff and Shaw 2000), which is below the noise limit established by the Park Service (82 dB at 82 feet or 25 meters). At 200 feet from the shoreline the sound level would decrease to just under 68 dB, which is an acceptable level of sound for recreation areas per federal noise abatement measures (FHWA 2000).

In most cases, PWC users would be dispersed along the shoreline so that watercraft would be infrequent at any given location and operating for short periods of time. Locations having negligible adverse impacts would be areas of concentrated use, especially marinas and beaches, where PWC sounds compete with noise from other visitors, automobiles, and motorboats, as well as wind and waves. This would include the boat launches, beaches, and marinas at Diablo East, Rough Canyon, Spur 454, and San Pedro Canyon.

Boaters who camp along the shoreline may be more sensitive to sound levels and PWC activity. PWC use adjacent to shoreline campers would have negligible adverse impacts to the soundscape because related noise would be heard only during daytime hours, when boat campers may have left the campsite to participate in activities at another location. Also, areas such as the upper Devils River may be more noise sensitive compared to boat launches, beaches, and marinas. These areas would have minor adverse impacts to their soundscape as well. Other noise sensitive receptors within the recreation area include residential communities. Three residential communities are established along the shoreline, which include Box Canyon, Amistad Acres, and Devils Shores. Scattered residences

also exist at Lakeview, along Rough Canyon, and near Diablo East. All these residential sites would have minor adverse impacts to their soundscape.

Noise impacts from personal watercraft under alternative A are expected to be short term, minor to moderate, and adverse. Minor impacts would occur when use is infrequent and distanced from other park users, for example, when PWC users operate far from the shoreline. Moderate impacts would occur from concentrated use during the peak season, particularly in the areas near Diablo East, Rough Canyon, Spur 454, and San Pedro Canyon, where swimmers or anglers are present. This would occur as a result of PWC use conflicting with quieter uses such as swimming, fishing, picnicking, and camping. In general, impacts to those seeking a quiet visitor experience would most likely be minor to moderate because PWC use would not be constant throughout the day, and the overall enjoyment of visitors would not be compromised. All noise impacts would be short term, since noise would generally be for a limited duration. Impacts could be reduced over the long term as a result of new technologies to reduce sound levels on 1999 and newer models (Sea-Doo 2000; Hayes 2002). Additionally, by 2006 the EPA requirements will result in reduced noise levels in association with improved engine technology (US EPA 1996b).

Cumulative Impacts. Other noise sources in Amistad National Recreation Area include other boats and other visitor activities, as well as natural sounds (wave action on the shore, wind blowing through trees). Boating activities are capable of generating noise levels as high as personal watercraft due to the number of motorboats (daily use is projected to increase from roughly 175 in 2002 to 213 in 2012 based on park estimates of a 2% yearly increase) and their potential area of operation. Although many motorboats can generate higher sound levels than personal watercraft, they are generally not perceived to be as annoying due to their typical steadier rate of speed and direction.

Similar to personal watercraft, numerous variables affect the perceived noise levels of other boats, including the number of boats and their proximity to other visitors. Additionally, motorboat activity is an expected occurrence at Amistad and is generally more acceptable to visitors. On a cumulative basis, PWC and boating noise would continue to have minor to moderate, adverse impacts because it would be heard occasionally throughout the day at low to moderate levels, but the noise would not be overly disruptive to visitors in areas where such uses are consistent with park objectives. All impacts would be short term since noise would usually be for a limited duration.

Other visitors would also contribute to the soundscape, including beach users, picnickers, and campers. However, these sounds are considered more acceptable and compatible with typical uses within the national recreation area. Visitor noise would have a negligible adverse effect on the soundscape at Amistad National Recreation Area.

Conclusion. Noise from personal watercraft would continue to have short-term, minor, adverse impacts at most locations throughout the use season, and short-term, minor to moderate, adverse impacts along the reservoir shoreline and at shoreline camping locations because personal watercraft could be heard occasionally throughout the day during the peak visitor season. Impact levels would be related to the number of personal watercraft, as well as the sensitivity of other visitors. Over the long term newer engine technologies could result in reduced noise levels.

Cumulative noise impacts from personal watercraft, motorboats, and other visitors would be short term and minor to moderate because these sounds would be heard occasionally throughout the day. For the most part, natural sounds would still predominate at most locations within the national recreation area. The highest sound impacts would occur near boat launches, beaches, and marinas.

This alternative would not result in an impairment of the Amistad National Recreation Area's soundscape.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. Daily PWC use levels would be the same as for alternative A. However, no PWC use would be allowed east of buoy SPC-1 in San Pedro Canyon, north of buoy P on Devils River, north of buoy 28 on the Rio Grande, or on the Pecos River (a tributary of the Rio Grande).

In most cases, personal watercraft would be dispersed along the reservoir so that operating watercraft would be infrequent at any given location; however, closing the areas to use could concentrate PWC use within the remaining available areas, such as Castle Canyon. This would result in a beneficial impact in swim beach areas, which are concentrated in the San Pedro area (see the "Affected Environment" chapter) and minor adverse impacts to more remote areas along the reservoir shoreline. Visitors in areas such as Castle Canyon would experience minor to moderate adverse impacts, as would residents along the reservoir shoreline at Amistad Acres, Box Canyon Estates, Lakeview, Rough Canyon, and near Diablo East. In the main reservoir area the frequency and duration of PWC noise would not change substantially because PWC use would be redistributed throughout the area.

Areas of the park closed to PWC use (such as the upper Devils River and San Pedro Canyon) would experience reduced noise levels. This would benefit non-PWC users who visit these areas, as well as residents along the Devils River at Devils Shores, because they would no longer hear PWC engines. Non-PWC users would also benefit from closing the Pecos River and the northern section of the Rio Grande to PWC use; however, these areas are rarely visited by PWC users due to lower water levels and distance from other amenities.

Overall, alternative B would have minor to moderate adverse impacts from PWC-generated noise in the main reservoir and portions of the Rio Grande. Residents along the Devils River would experience beneficial impacts. Negligible impacts would occur when use was occasional and distanced from other park users, for example, PWC users operating far from shore. Minor to moderate impacts would occur from concentrated use, particularly near Diablo East, Rough Canyon, and Spur 454, where the level of noise could be heard occasionally. Minor adverse impacts at sites such as Castle Canyon would occur mainly where PWC use would conflict with other quieter uses, such as fishing, swimming, or camping. In general, the impact to those seeking a quiet visitor experience would most likely be minor because PWC use would not be constant throughout the day and because the overall enjoyment of the typical visitor activities in the area would not be compromised. All noise impacts would be short term, since noise would generally be for a limited duration. Impacts could be reduced over the long term as a result of new technologies to reduce sound levels on 1999 and newer models (Sea-Doo 2000; Hayes 2002). Additionally, by 2006 the EPA requirements will result in reduced noise levels in association with improved engine technology (US EPA 1996b).

Cumulative Impacts. The cumulative effect of PWC and boating noise would continue to have short term, minor, adverse impacts at most locations because it would be heard occasionally throughout the day. In backcountry areas along the Rio Grande, Pecos, San Pedro Canyon and Devils Rivers there would be a beneficial impact because personal watercraft would no longer contribute to noise levels within these areas.

Conclusion. Noise from personal watercraft would continue to have short-term, minor, adverse impacts at most locations throughout the use season, and minor to moderate, adverse impacts along the

reservoir shoreline. Impact levels would be related to the number of personal watercraft operating, as well as the sensitivity of other visitors. Eliminating PWC use in specific areas would have beneficial impacts, since PWC engines would not be heard and there would be less impact to residents and quiet uses in these areas. Over the long term newer engine technologies could result in reduced noise levels.

Cumulative noise impacts from personal watercraft, motorboats, and other visitors would be short term and minor, with these sounds heard occasionally throughout the day. For the most part, natural sounds would still predominate at most locations within Amistad. The highest sound increase impacts would occur near Diablo East and Spur 454, and the highest decreases would occur along the Devils River and in San Pedro Canyon.

This alternative would not result in an impairment of the national recreation area's soundscape.

Impacts of the No-Action Alternative — No PWC Use

Analysis. Under the no-action alternative personal watercraft would be banned from operating within the Amistad National Recreation Area. On most days there would be a beneficial impact on shoreline visitors because PWC noise would be eliminated.

Cumulative Impacts. Cumulative impacts for the no-action alternative would be similar to alternative B. Eliminating PWC-related noise within the national recreation area would result in a beneficial impact; however, other motorized boating activities would continue to have short-term, minor, adverse noise impacts throughout the day. The highest level of impact would occur near the Diablo East boat launch.

Other visitor uses contribute to the area's soundscape, including beach activities, picnicking, and camping. However, these sounds are considered more acceptable and compatible with other uses.

Conclusion. The overall decrease in noise generated by personal watercraft would be a beneficial impact because PWC noise would no longer occur within the recreation area.

Cumulative noise impacts from motorboats and other visitor activities would be short term, minor, and adverse, particularly near the Diablo East boat launch, but there would be no contribution from PWC use within Amistad.

This alternative would not result in an impairment of the national recreation area's soundscape.

WILDLIFE AND WILDLIFE HABITAT

Some research suggests that personal watercraft affect wildlife by interrupting normal activities. This is thought to be caused by PWC speed, noise, and access. Flight response is the most likely impact of PWC use. PWC use can affect an animal's ability to feed, rest, and breed if it is unable to habituate to the disturbance caused by PWC operations.

Impacts to threatened or endangered or sensitive species, such as the interior least tern, are documented under "Threatened, Endangered, or Special Concern Species."

GUIDING REGULATIONS AND POLICIES

The NPS Organic Act, which directs parks to conserve wildlife unimpaired for future generations, is interpreted by the agency to mean that native animal life should be protected and perpetuated as part of the park's natural ecosystem. Natural processes are relied on to control populations of native species to the greatest extent possible; otherwise, they are protected from harvest, harassment, or harm by human activities. According to NPS *Management Policies 2001,* the restoration of native species is a high priority (sec. 4.1). Management goals for wildlife include maintaining components and processes of naturally evolving park ecosystems, including natural abundance, diversity, and the ecological integrity of plants and animals.

There are no additional federal, state, or local regulations or policies for wildlife and wildlife habitat at Amistad National Recreation Area.

METHODOLOGY AND ASSUMPTIONS

Potential impacts to wildlife and wildlife habitat were evaluated based on the pattern of use of motorized watercraft in Amistad Reservoir, the natural habitats present, and the professional judgment and observations of the project team and members of the park staff. The staff resources specialist, the U.S. Fish and Wildlife Service, and Texas Parks and Wildlife Department provided wildlife information. To assess the magnitude of impacts from PWC use on wildlife, the following assumptions were made:

1. Most PWC users operate their craft in a lawful manner and abide by state laws and the "Superintendent's Compendium" (i.e., operating at no-wake speeds within 50 feet of the shore and not operating between sundown and sunrise).
2. PWC users who disembark on the shoreline would travel no more than 100 feet, staying within eyesight of their craft.
3. The maximum number of PWC users is an average of 32 during busy summer weekends, for an average of four hours of operation.
4. Impacts in 2012 would be greater than those in 2002 since visitor numbers are projected to increase and PWC use is projected to increase by 1.5% per year, to a total of 37.

IMPACT ANALYSIS AREA

The impact analysis area includes the areas of Amistad Reservoir open to PWC use prior to November 6, 2002, and extending inland approximately 200 feet. This 200-foot inland area is assumed to provide a more encompassing range of assessment based on the distance of PWC operation from the shoreline and wildlife responses to PWC activity.

IMPACT OF PWC USE AND NOISE ON WILDLIFE AND HABITAT

The following thresholds were used to determine the magnitude of effects on wildlife and wildlife habitat:

Negligible: No wildlife species are present; no impacts or impacts with only temporary effects are expected.

Minor: Nonbreeding animals are present, but only in low numbers. Habitat is not critical for survival; other habitat is available nearby. Occasional flight responses by wildlife are expected, but without interference with feeding, reproduction, or other activities necessary for survival.

Moderate: Breeding animals are present; animals are present during particularly vulnerable life-stages, such as migration or juvenile stages; mortality or interference with activities necessary for survival are expected on an occasional basis, but are not expected to threaten the continued existence of the species in the park.

Major: Breeding animals are present in relatively high numbers, and/or wildlife are present during particularly vulnerable life stages. Habitat targeted by PWC use or other actions has a history of use by wildlife during critical periods and is somewhat limited. Mortality or other effects are expected on a regular basis and could threaten the continued survival of the species in the park.

Impairment: Some of the major impacts described above might be an impairment of park resources if their severity, duration, and timing resulted in the elimination of a native species or significant population declines in a native species. In addition, these adverse, major impacts to park resources and values would

contribute to deterioration of the park's wildlife resources and values to the extent that the park's purpose could not be fulfilled as established in its enabling legislation;

affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or

affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. PWC use could affect wildlife wherever motorized vessels are authorized under the "Superintendent's Compendium," which (1) closes Hidden Cave Cove, Painted Canyon, and Seminole Canyon to the public, and (2) prohibits vessels from landing on islands or operating within harbors, mooring areas, and any no-wake areas marked by buoys or signs. Numbers of personal watercraft using the reservoir during a high-use day would increase from 32 per day in 2002 to 37 per day in 2012, an average increase of 1.5% per year (see Table 20). While some PWC use occurs year-round, most use occurs from May to September. PWC use is most frequent during weekends, followed by weekday evening hours. While personal watercraft would be distributed throughout the reservoir, the primary location for potential impacts would be where PWC use is most prevalent: the San Pedro arm of the reservoir (at the end of Spur 454) and the Indian Springs area in the upper Devils River. Disturbance could occur on the Rio Grande from PWC users beaching their craft. The Pecos River contains rocks that would make it difficult for PWC operators to disturb wildlife there, and only about 10 PWC visits occur there each year (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 1 2002, re: water and use). Since no PWC operation is allowed between sundown and sunrise, impacts are less likely for nocturnal than for diurnal species.

Wildlife are most likely to be found near the shoreline due to habitat constraints, with few non-aquatic species present on the water surface 200 feet (or more) from shore (other than bats and nesting interior least terns, which are discussed below under "Threatened, Endangered, or Special Concern Species"). When a PWC user travels to a shoreline destination, the watercraft must be slowed to a no-wake speed, thus allowing wildlife to easily move out of the way. There have been no documented cases of

PWC operators deliberately harassing or chasing birds of other wildlife on Lake Amistad, and no documented collisions with waterfowl or wildlife.

There can be considerable variation in flush distances of waterbirds in response to PWC use among individuals within the same species and among different species (Rodgers and Schwikert 2002). Waterfowl migrate to Amistad during the winter when there is less PWC use due to colder water. Since most personal watercraft are not used in the early spring due to water and air temperatures, it is unlikely that most wildlife would be disturbed during the breeding season. During rearing, PWC use could cause short-term temporary effects when they land. Due to the low habitat productivity and lack of colonial wildlife along the reservoir, as well as the low number of PWC users, impacts to wildlife and wildlife habitat would be negligible at most locations.

As noted in the "Water Quality" section, continued use of PWC would create pollutant loads that are well below water quality criteria and ecotoxicological benchmarks, so there would likely be no or negligible impacts to fish related to water contamination. Also, fish will avoid personal watercraft, and PWC use is not expected to disrupt any spawning areas, given the restrictions on their use near shorelines in shallow areas.

Continued PWC use at Amistad National Recreation Area would have negligible or no adverse impacts to fish, and negligible to minor impacts to waterfowl and other wildlife. There would be no perceptible changes in wildlife populations or their habitat community structure. All impacts to fish, wildlife, and habitat due to PWC use would be temporary and short term. The intensity or duration of impacts is not expected to increase substantially over the next 10 years, since PWC numbers would not increase substantially.

Cumulative Impacts. Potential cumulative effects on wildlife are related to several activities that could occur in proximity to wildlife species. These activities include other visitors accessing the shoreline and other boaters traveling on the water or accessing the shoreline. Other motorized watercraft use Amistad National Recreation Area, in addition to personal watercraft. On busy summer weekends, PWC use accounts for only 8% to 20% of total boating activity; on weekdays PWC use comprises 19% to 40% of total boating activity (NPS 2002b). Numbers of motorboats using the reservoir (other than personal watercraft) during a high-use day are projected to increase from 175 per day in 2002 to 213 per day in 2012, an average increase of 2% per year.

Wildlife routinely exhibit movement or flight response due to visitor proximity. A study conducted in Florida showed no substantial difference in flush distance between the rapid approach of personal watercraft and other motorized vessels, and other motorized vessels more often elicited a substantially greater flush distance than did personal watercraft (Rodgers and Schwikert 2002). However, interactions with personal watercraft, boats, or other shoreline visitors would not interfere with feeding, reproduction, or other activities necessary for the survival of wildlife species. Interactions between wildlife and humans would be limited because shoreline use tends to be concentrated around developed facilities, where habitat characteristics are lacking compared to undeveloped shoreline. Overall, visitors (including PWC users) at Amistad National Recreation Area would have negligible to minor adverse impacts to wildlife that are dispersed over a large area and along the shoreline. All wildlife impacts would be temporary and short term.

Conclusion. Due to the distance that PWC users are required to operate from the shoreline, impacts on wildlife and wildlife habitat would be negligible at most locations. The effects from PWC speed and noise or proximity to wildlife would be limited because PWC users must operate at no-wake speeds within 50 feet of the shore. In addition, few wildlife occur on the open water, where speeds are higher.

On a cumulative basis, all visitor activities would continue to have negligible to minor adverse effects on wildlife and wildlife habitat. All wildlife impacts would be temporary and short term.

Implementation of this alternative would not result in an impairment to wildlife or wildlife habitat.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. PWC use under alternative B would continue to be allowed under the same restrictions as under alternative A, but would be banned from the Pecos River, Rio Grande north of buoy 28, Devils River north of buoy P, and San Pedro Canyon east of buoy SPC-1. Other motorboats would be able to continue using these areas. Overall numbers of personal watercraft would remain the same as in alternative A, with maximum use projected to increase from 32 per day in 2002 to 37 per day in 2012. PWC impacts to wildlife and habitat would be similar to those described for alternative A, although the areas of potential impact would be reduced, with more protection for the upstream portions of the reservoir.

Continued PWC use at Amistad National Recreation Area would have negligible or no adverse impacts to fish, and negligible to minor adverse impacts to waterfowl and other wildlife. There would be no perceptible changes in wildlife populations or their habitat community structure. All impacts to fish, wildlife, and habitat due to PWC use would be temporary and short term. The intensity or duration of impacts is not expected to increase substantially over the next 10 years, since PWC numbers would not increase substantially.

Cumulative Impacts. The contribution to cumulative impacts from non-PWC sources would be the same as described for alternative A. Under alternative B there would be a negligible reduction in overall impacts caused by limiting PWC use areas. Visitor interactions would not interfere with feeding, reproduction, or other activities necessary for the survival of wildlife species.

Overall, PWC and other motorized boat use would have negligible or no adverse impacts to fish, and negligible to minor impacts to waterfowl and other wildlife. There would be no perceptible changes in wildlife populations or their habitat community structure. All impacts to fish, wildlife, and habitat due to PWC use would be temporary and short term. The intensity or duration of impacts is not expected to increase substantially over the next 10 years, since PWC numbers would not increase substantially.

Conclusion. Under alternative B there would be a reduction in overall impacts caused by PWC use, due to limited areas of use. Because PWC users are required to operate at no-wake speeds within 50 feet of the shore, impacts on wildlife and wildlife habitat would be negligible at most locations. In addition, few wildlife occur on the open water, where PWC speeds are higher.

On a cumulative basis, all visitor activities would continue to have negligible to minor adverse effects on wildlife and wildlife habitat. All wildlife impacts would be temporary and short term.

Implementation of this alternative would not result in an impairment to wildlife or wildlife habitat.

Impacts of the No-Action Alternative — No PWC Use

Analysis. Banning PWC use within the national recreation area would eliminate any potential impacts to wildlife or habitats, including direct contact, noise disturbances, air or water toxicity from exhaust,

or shore access by PWC users. There would be beneficial, short-term impacts relative to those described for alternative A.

Cumulative Impacts. Cumulative impacts would be similar to those described for alternative A, except that PWC contribution to these impacts would be eliminated. Overall, there would be negligible or no adverse impacts to fish, and negligible to minor impacts to waterfowl and other wildlife. There would be no perceptible changes in wildlife populations or their habitat community structure.

Conclusion. Prohibiting PWC use in Amistad National Recreation Area would eliminate any potential related impacts to wildlife and habitat.

Cumulative impacts from other visitor uses would continue and would have negligible or no adverse impacts to fish, and negligible to minor impacts to waterfowl and other wildlife. There would be no perceptible changes in wildlife populations or their habitat community structure.

This alternative would not result in an impairment of wildlife or wildlife habitat.

THREATENED, ENDANGERED, OR SPECIAL CONCERN SPECIES

PWC use may harm threatened or endangered species and/or their habitat. One federally listed species, the interior least tern, arrives at Amistad each spring to nest and leaves by late August. The park already implements a plan to protect this species, which appears to be bothered by PWC use only if users beach and walk on nesting islands (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Aug. 22 2002, re: least tern islands). Behavior of other state or federally listed species (for example, the brown pelican) may be affected by PWC use.

GUIDING REGULATIONS AND POLICIES

The Endangered Species Act (16 USC 1531 et seq.) mandates that all federal agencies consider the potential effects of their actions on species listed as threatened or endangered. If the National Park Service determines that an action may adversely affect a federally listed species, consultation with the U.S. Fish and Wildlife Service is required to ensure that the action will not jeopardize the species' continued existence or result in the destruction or adverse modification of critical habitat.

State and federally listed species were identified through discussions with park staff, informal consultation with the U.S. Fish and Wildlife, and the Texas Parks and Wildlife Department. A letter requesting a current list of federal threatened, endangered, and special concern species that are known to occur or may occur within or adjacent to PWC use areas within the boundaries of Lake Amistad was sent to the U.S. Fish and Wildlife Service. The Texas Parks and Wildlife Department was also contacted to identify state threatened, endangered, and special concern species; however, the park has received no reply from either agency to date.

An analysis of the potential impacts to each species that information was requested on is included in this section. It has been determined that none of the alternatives would be likely to adversely affect any of the listed species at Amistad. The completed environmental assessment will be submitted to the U.S. Fish and Wildlife Service for its review. If the agency concurs with the finding of the National Park Service, no further consultation will be required.

Formal consultation would be initiated if the National Park Service determined that actions in the preferred alternative would be likely to adversely affect one or more of the federally listed threatened or endangered species identified in the park. At that point a biological assessment would be prepared to document the potential effects. From the date that formal consultation was initiated, the Fish and Wildlife Service would be allowed 90 days to consult with the agency and 45 days to prepare a biological opinion based on the biological assessment and other scientific sources. The Fish and Wildlife Service would state its opinion as to whether the proposed PWC activities would be likely to jeopardize the continued existence of the listed species or to result in the destruction or adverse modification of critical habitat. Such an opinion would be the same as a determination of impairment. To ensure that a species would not be jeopardized by PWC activities, the National Park Service would confer with the Fish and Wildlife Service to identify recommendations for reducing adverse effects and would integrate those into the preferred alternative.

NPS *Management Policies 2001* state that potential effects of agency actions will also be considered on state or locally listed species. The National Park Service is required to control access to critical habitat of such species, and to perpetuate the natural distribution and abundance of these species and the ecosystems upon which they depend.

ASSUMPTIONS AND METHODOLOGIES

Primary steps in assessing impacts on listed species were taken to determine the following:

1. which species are found in areas likely to be affected by management actions described in the alternatives
2. current and future use and distribution of personal watercraft by alternative
3. habitat loss or alteration caused by the alternatives
4. displacement and disturbance potential of the actions and the species' potential to be affected by PWC activities

The information in this analysis was obtained through best professional judgement of park staff and experts in the field (as cited in the text), and by conducting a literature review. In conducting this assessment, several basic assumptions were made, as follows:

- When personal watercraft land or launch, they operate at no-wake speed.
- Most visitors use existing trails and do not walk off trail.
- PWC and boat users who access the shore do not stray far from their craft and are likely to stay within eye contact when visiting the shore.

The PWC and visitor use trends data were used to evaluate potential impacts to threatened or endangered species. Additional information was obtained from park staff. Wildlife information was provided by the park's natural resources specialist, the U.S. Fish and Wildlife Service, and Texas Parks and Wildlife Department (see appendix C).

IMPACT ANALYSIS AREA

The impact analysis area is the portion of Amistad Reservoir open to PWC use, as specified in the "Superintendent's Compendium." PWC noise may disturb wildlife along the shore, extending inland approximately 200 feet. This 200-foot inland area is assumed to provide a more encompassing range

of assessment based on the distance of PWC operation from the shoreline and the potential for wildlife responses to PWC activity.

IMPACT OF PWC USE ON SUCH SPECIES

The Endangered Species Act defines the terminology used to assess impacts to listed species as follows:

> *No effect:* When a proposed action would not affect a listed species or designated critical habitat.
>
> *May affect / not likely to adversely affect:* Effects on special status species would be discountable (i.e., extremely unlikely to occur and not able to be meaningfully measured, detected, or evaluated) or would be completely beneficial.
>
> *May affect / likely to adversely affect:* When an adverse effect to a listed species might occur as a direct or indirect result of proposed actions and the effect either would not be discountable or would be completely beneficial.
>
> *Is likely to jeopardize proposed species / adversely modify proposed critical habitat (impairment):* The appropriate conclusion when the National Park Service or the U.S. Fish and Wildlife Service identifies situations in which PWC use could jeopardize the continued existence of a proposed species or adversely modify critical habitat to a species within or outside park boundaries.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. PWC use would continue in all areas of the reservoir except where prohibited by the "Superintendent's Compendium" (i.e., no use in Hidden Cave Cove, Painted Canyon, within 300 feet of Amistad Dam; no landing on islands with nesting least tern colonies). Numbers of personal watercraft using the reservoir during a high-use day are estimated to increase from 32 per day in 2002 to 37 per day in 2012. Most use occurs from May to September and during weekends and weekday evening hours. While personal watercraft would be distributed throughout the national recreation area, the primary location for potential impacts to threatened and endangered species or their habitat would be where PWC use is most prevalent: the San Pedro arm of the reservoir (at the end of Spur 454) and the Indian Springs area in the upper Devils River arm of the lake. Since PWC operation is not allowed between sundown and sunrise, impacts are less likely for nocturnal animals than diurnal species.

The following summarizes the impacts that would be expected to the federal and state listed species discussed in the "Affected Environment" chapter. In many cases, species that were included in the discussion because they may occur in the park boundaries are not likely to occur in the more limited water and shoreline areas open to PWC use and other water-based activities, although they may be found elsewhere in the area. Impacts in 2012 are expected to be the same as in 2002 because use would only increase slightly, from 32 watercraft on a high-use day to 37 (see Table 20).

Wildlife Species

Federal Endangered Species

Birds. *Peregrine Falcon* (American, also state endangered, or Arctic) — PWC use is not likely to adversely affect either of these species. Neither is known to nest in the area, and the arctic peregrine falcon is listed only for its similarity in appearance to the American variety. As described in "Affected Environment," peregrine falcon sightings have been reported at Amistad throughout recent years, but these birds are likely transients. If peregrines did nest in the area, the nests would likely be located on cliff edges that would not be accessible to PWC users. Although foraging activities could be affected by PWC noise and physical presence, the disturbance would be temporary.

Black-capped Vireo (also state endangered) — PWC use is not likely to affect this species, since it is likely a transient and has been sighted only once (in 1993). Also, its known nesting areas lie outside the park, and PWC or other watercraft users would not likely be found in or near its preferred habitat (low brush on steep slopes of dry streambeds and mixed deciduous/evergreen shrubland).

Brown Pelican (also state endangered) — Brown pelicans have been observed feeding on fish in the reservoir several times during the past decade, and it is likely that they occur in areas used by PWC operators and other boaters. However, they are considered transients or migrants, not permanent residents of the area, as no nesting is known or expected in the park. As a result of their physical presence and noise, PWC use would have temporary impacts to pelicans feeding over the water, resulting in avoidance reactions and flight. For these reasons, PWC use may affect, but is not likely to adversely affect, this species.

Interior Least Tern (also state endangered) — This is the only federally listed endangered species that actively nests in the park. Noise levels and the activity associated with PWC use could adversely affect nesting or foraging terns, causing alarm or flight response and even abandonment of nests if the disturbance was severe and/or frequent. However, the park has implemented several mitigation measures to protect the tern colonies. PWC users are not permitted to land on islands where terns are nesting, and signs are posted in the water around these islands to warn visitors not to approach, thereby keeping PWC operators and other visitors at a safe distance. Although PWC users could operate within 50 feet of an island, park personnel report that nesting terns do not appear to be disturbed by the presence of personal watercraft or other motorboats. There is no documented instance of someone knowingly beaching a boat or personal watercraft and walking onto a nesting island marked with park warning signs (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Aug 22, 2002; re: least tern islands).

A census of interior least terns in various years since 1985 (NPS no date) shows that the number of terns at Amistad increased from 30 in 1989, to 135 in 1998, to 180 in 1999. Monitoring since then indicated a total of 129 terns in 2001 and 149 terns in 2002 (NPS 2002d). The census report indicates that nesting failure was related to increased water levels in the spring, inundating islands and shorelines. No mention is made of any nesting failure due to motorized watercraft use. Given the protection afforded to the interior least tern and the lack of any indication of adverse effects due to watercraft in the area, PWC use at Amistad may affect, but is not likely to adversely affect, this species.

Whooping Crane (also state endangered) — PWC use is not likely to adversely affect this species, since there have been no confirmed sightings of this bird at Lake Amistad and it is expected in the area only as an occasional transient.

Fishes. *Devils River Minnow* (also state threatened) — This fish is proposed as endangered, and its range includes the Devils River, generally in areas upstream of the park. It is found in small perennial stream channels and is restricted to areas upstream of the reservoir, where the streambed becomes hard limestone rock that is difficult for boats, including canoes, to access. This species requires free-flowing water, not standing water such as a reservoir. Its habitat consists of rocky runs and flowing pools, which would not be accessible by PWC users and would be upstream of any PWC pollutant discharge. Therefore, this species is not likely to be adversely affected by PWC use.

Federal Threatened Species

Arctic Peregrine Falcon — See American peregrine falcon.

Bald Eagle (also state endangered) — The bald eagle is known as a transient in this area and occurs only during the winter months, when PWC use is minimal. Some temporary impacts could occur during feeding activities. PWC use may affect, but is not likely to adversely affect, this species.

Piping Plover (also state endangered) — PWC use is not likely to adversely affect this species. There have been no confirmed sightings of this bird at Lake Amistad, and it is expected in the area only as an occasional transient.

Federal Candidate Species

Mountain Plover — This species has not been documented in the park, but is known to spend summer months in this region of Texas. However, these plovers prefer areas of freshly cut grass, not areas frequented by PWC or found along the shoreline of the lake. Therefore, it is not likely that PWC use would result in any impact to this species.

Federal Species of Concern

Amphibians. *Texas Salamander* — Adverse impacts from PWC use are not likely, since this salamander does not frequent dry shorelines, but rather small subterranean streams and spring seeps. Also, none has been documented in the park since 1963.

Birds. *Audubon's Oriole* — Although this species may exist at Amistad, it prefers habitat of dense brushland dominated by mesquite or Texas ebony, which is not found along shorelines frequented by PWC users. Therefore, adverse impacts are not likely from PWC use.

Black Tern and Ferruginous Hawk — Both of these species are considered accidental or irregular visitors to the area, and PWC use would not likely result in any adverse impacts, since so few individuals pass through the area and no nesting is known. Also, the hawk prefers to nest in conifers, which do not exist in the park, or in areas not accessed by PWC users.

Mexican Hooded Orioles — This species is known to nest adjacent to the dam and prefers dense brushland dominated by mesquite or Texas ebony. The areas that this bird inhabits are not frequented by PWC users or the shorelines that may be accessed, and no adverse impacts are likely.

Texas Olive Sparrow — This bird has been seen frequently in the park, but also prefers a habitat of dense brushland dominated by mesquite or Texas ebony. Therefore, like the Mexican hooded oriole, no adverse impacts are likely since PWC users do not operate in or near the preferred habitat of this species in the park.

Western Burrowing Owl — This species inhabits burrows in or near a campground at Amistad and is not known or expected along the hard limestone, gravely shoreline that might be accessed by PWC users. Therefore, no adverse impacts are likely from PWC use.

White-faced Ibis (also state threatened) — This species probably occurs as a migrant only, since it prefers a habitat not found within the park — marshes and swampy areas. It could feed at the park on small aquatic insects and fish along the shorelines, but PWC use would have no more than temporary impacts to these birds, and no adverse impacts on nesting birds or populations are expected.

Fishes. *Blotched Gambusia* (state endangered), *Blue Sucker, Conchos Pupfish, Proserpine Shiner, Rio Grande Darter, Chihuahua Shiner* (all state threatened), *Rio Grande Shiner* — Although some of these fish species are more likely to occur in Lake Amistad and its inflowing rivers, none is likely to be adversely affected by PWC use. These fish are found in small perennial stream channels and are restricted to a few sites upstream of the reservoir. They require free-flowing water, not standing water such as a reservoir. In addition, PWC users do not go into areas of strong currents, stream riffles and pools, or other shallow areas that could be used for spawning or by juvenile fishes. Fish can also easily avoid oncoming personal watercraft and usually do not frequent the water surface where the jet action of PWC engines occurs. Also, as noted in the "Water Quality" section of this document, continued PWC use would create pollutant loads that are well below water quality criteria and ecotoxicological benchmarks, so these species are not likely to be adversely affected.

Invertebrates. *Salina Mucket, Texas Hornshell, Mexican Fawnsfoot* — Any of these species may occur in Lake Amistad, but they would be found within the bottom sediments and would not be directly impacted by PWC use. Indirect impacts would be primarily related to the discharge of pollutants and possible accumulation of PAHs in the sediment. However, the water quality analysis shows that the criteria for aquatic life would not be exceeded at Lake Amistad, and none of these species is likely to be adversely affected by PWC use.

Mammals. *Bats (Cave Myotis, Greater Western Mastiff Bat, Pale Townsend's Big-Eared Bat, Yuma Myotis)* — Suitable roosting habitat for all these species (caves, crevices, tunnels, hollow trees) exists around Lake Amistad, and most species have been collected nearby or within the boundaries of the national recreational area. However, the bats would be found in PWC use areas only when they are feeding and generally only after dusk or at night. Therefore, there would be no effect from PWC operation, since they are not used when bats are feeding, and PWC operators would not use areas where bats roost.

Reticulate Collared Lizard (also state threatened) — This species is not likely to be adversely affected since it is a resident of thornbush deserts that are not found along the immediate shoreline environment where PWC use occurs. Also, it has not been observed in the park.

Texas Horned Lizard (also state threatened) — It is not likely that this lizard would frequent PWC use areas, although it has been observed within the park and could possibly occur along the upper edges of the more remote and less disturbed shorelines. The lizard is active during the daytime until it retreats into shaded areas to avoid the most intense heat of the day.

Because it would avoid noise or disturbance and is usually not active during hot daylight hours, impacts from PWC use would not likely adversely affect this species.

State Endangered Species

Fishes. *Phantom Shiner and Bluntnose Shiner* — Similar to the federally listed species of fish, adverse impacts are not likely to occur to these species. The phantom shiner is thought to be extinct, and if the bluntnose shiner is present, PWC users do not generally go into areas that could be used for spawning or by juvenile fishes. These fish occur in perennial streams upstream of the main body of the reservoir. They require flowing water and would not found in standing water, such as a reservoir. In addition, fish can also easily avoid oncoming personal watercraft and usually do not frequent the water surface where the jet action of PWC engines occurs. Also, as noted in the "Water Quality" section, continued PWC use would create pollutant loads that are well below water quality criteria and ecotoxicological benchmarks, so these species are not likely to be adversely affected.

Mammals. *Black Bear* — This state endangered mammal is likely to occur within the park, but would not be expected along sparsely vegetated and bare shorelines, although it may be present in the upstream areas along incoming rivers. All sightings of this bear were of transients passing through the park. Since PWC use would not affect denning or even transient bears, no impacts are likely to affect this species.

State Threatened Species

Birds. *Zone-tailed Hawk and Wood Stork* — Both of these species are considered only occasional visitors, and there have been no confirmed sightings or nesting in the park. Although the presence of and noise associated with PWC use could disturb these birds if they are feeding along the shorelines or passing by PWC use areas, these species are not likely to be adversely affected.

Reptiles. *Texas Indigo Snake, Texas Tortoise, Big Bend Blackhead Snake* — None of these species is aquatic or favors habitat at the water's edge, although they may occasionally come near more undisturbed portions of the reservoir. Both the tortoise and the indigo snake require open areas with somewhat sandy soils, a combination that is not common at Amistad. All snakes will avoid human noise and presence, and the tortoise has been observed only in upland areas. PWC users are not expected to come on these animals, and adverse impacts would not be likely.

State Special Concern Species

Hairy–legged Vampire Bat — Like the federally listed bat species, suitable roosting habitat (caves, tunnels) exists around Lake Amistad, but the bats would be found over PWC use areas only when feeding and generally only after dusk or at night, when PWC use is prohibited. Therefore, no impacts from PWC use are expected.

Plant Species

Federal and State Endangered Species

Texas Snowbell and Tobusch Fishhook Cactus. Both plants are thought to occur in the park, but no confirmed sightings have been reported. Documented sightings have occurred in the Dolan Springs natural area, which is a short distance upstream from the park boundary on the Devils River. It is possible that the plants could occur within the park in this general area, but it is not likely that PWC users would access their preferred habitats. The snowbell is found on limestone outcrops along perennial watercourses and in certain woodlands; the cactus prefers short grasslands on limestone uplands or gravel in dry creek bottoms. PWC users would be in the water or on gradual shorelines, which is not where these plants occur. The plants occur in areas away from the water that are not accessed by visitors using the reservoir. Therefore, these species are not likely to be adversely affected.

Federal Species of Concern

Cliff bedstraw, Correll's false dragon-head, perennial caltrop, Rydberg's scurfpea, sabinal prairie-clover, Sonora fleabane, Texas greasebush, Texas trumpet, Warnock's rock-daisy, Wright's water willow. These 10 plants on the federal species of concern list may occur within Amistad National Recreation Area, but none has been sighted within the park boundaries and few (if any) plants are expected to be within the shoreline study area. Of the 10 species, only the Correll's false dragon-head and the Wright's water willow have preferred habitat along streams or in perennially wet areas that could possibly be accessed by PWC users if they land on shore — the remaining species exist only outside of the inundation zone. However, PWC users do not venture far from their landing areas, tend to stay in one area along the shoreline, and primarily use those landings and launch areas that are already disturbed. Therefore, it is unlikely that overland traffic associated with PWC use would adversely impact any of these plant species.

Cumulative Impacts. Cumulative effects to the animal and plant species discussed above would include impacts from additional human presence and other water-based recreational activities (boating, swimming, diving), plus some additional minor disturbance from those visitors who use more upland areas to picnic, camp, hike, and hunt. There are no other major foreseeable planned actions or factors in the area, including other sources of water pollution, that would contribute more than very minor adverse impacts to any of the species — with the possible exception of fluctuating water levels that do affect the interior least tern — contributing to overall cumulative impacts to this species. Other visitors and non-PWC boaters could affect sensitive species and habitat as a result of trampling and/or interrupting normal activities because of noise, but most of these visitors would be concentrated in and around areas that have already disturbed or developed, such as boat ramps, marinas, campgrounds, and the visitor center.

Overall, cumulative effects from all park visitor activities are not likely to adversely affect these species, since the identified species are either not present where the activities occur or are not normally accessible.

Conclusion. Overall, continued PWC use at Amistad would have no effect or would not likely adversely affect any federal or state listed species, since the identified species are either not present as permanent residents, do not have preferred habitat in PWC use areas, or are not normally accessible.

Cumulative effects from all park visitor activities are not likely to adversely affect these species since the identified species are not present, do not nest in the park, or are not accessible during the course of normal visitor activities, which are primarily water-based recreation.

This alternative would not result in an impairment of threatened, endangered, or special concern animal or plant species.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. This alternative would allow continued PWC use, but use would be prohibited in the Pecos River and the upstream reaches of the Rio Grande and Devils River, and in Pedro Canyon (which includes several higher use areas for personal watercraft). Two boat ramps at San Pedro Canyon would also be closed and the Pecos River boat ramp would be closed to PWC use. These restrictions would remove potential impacts associated with PWC use in these areas. PWC use would result in possible impacts in more open water area of the reservoir and at other boat ramps. These impacts would be the same as those described for alternative A for all species discussed, since none of the areas closed to PWC use is known to be essential or highly used habitat by any of these species relative to the rest of the reservoir, except for the listed fish, particularly the Devils River minnow. Displacement of PWC use to other high use areas would possibly increase impacts to species in these areas, such as feeding brown pelicans or bald eagles. Impacts for 2012 are expected to be the same for 2002, due to the slight anticipated 1.5% increase in PWC use, from 32 on a high-use day to 37 (see Table 20).

Areas closed to PWC use would be more likely to have listed plant species within their watersheds, and keeping PWC operators to already disturbed boat ramps and more open water would lessen the chances of impact from PWC users landing and walking around the area.

Cumulative Impacts. Cumulative effects for PWC users and other visitors would be similar to alternative A and would not likely adversely affect concerned species or their habitat, since the identified species are not present as permanent residents or are not normally found in areas frequently accessed by boaters and shoreline users. Again, most of the other uses at Amistad are focused on water-based recreation, so that additional visitors would not likely enter other areas where many of the listed species could be found.

Conclusion. Overall, continued PWC use at Amistad would have no effect or would not likely adversely affect any federal or state listed species, since the identified species are either not present as permanent residents, do not have preferred habitat in PWC use areas, or are not normally accessible. Restricting PWC use in several of the more upstream areas of the rivers and limiting their access would reduce the chances of adverse impacts to those species that utilize these areas more, and would potentially increase the minor disturbance to species using open water.

Cumulative effects from all park visitor activities are not likely adversely affect these species, since the identified species are not present or are not accessible during the course of normal visitor activities, which primarily includes water-based recreation.

This alternative would not result in an impairment of threatened, endangered, or special concern species.

Impacts of the No-Action Alternative — No PWC Use

Analysis. No PWC use would be allowed within Amistad National Recreation Area, thus eliminating any potential impacts on listed species.

Cumulative Impacts. PWC contribution to overall cumulative impacts to federal or state listed animal and plant species would be eliminated. Other visitor activities are not likely to adversely affect federal or state listed animal and plant species, similar to alternatives A and B. Generally, these species are not present or are not accessible during the course of normal visitor activities.

Conclusion. Because PWC use would be prohibited in Amistad National Recreation Area, there would be no effect on federal or state listed species.

On a cumulative basis, the activities of other visitors and other boaters would not likely adversely affect federal or state listed animals and plants because generally the species are not present or are not accessible during the course of normal visitor activities. PWC contribution to overall cumulative impacts to federal or state listed animal and plant species would be eliminated.

This alternative would not result in an impairment of threatened, endangered, or special concern species.

SHORELINES AND SHORELINE VEGETATION

Personal watercraft provide access to the shoreline, and operators may disembark to explore, sunbathe, or beachcomb. As a result, shoreline vegetation could be trampled in order to access shoreline areas or to explore along the shore. Due to physical characteristics of the shoreline, the reservoir does not have submerged aquatic vegetation that could be impacted by PWC use.

GUIDING REGULATIONS AND POLICIES

Natural shoreline processes such as erosion, deposition, dune formation, overwash, inlet formation, and shoreline migration should continue without interference. Where the nature or rate of natural shoreline processes has been altered, the National Park Service is directed to identify alternatives for mitigating the effects of such activities or structures and for restoring natural conditions (NPS *Management Policies 2001,* sec. 4.8.1.1). The National Park Service must also comply with the provisions of Executive Order 11990 ("Protection of Wetlands"), which requires federal agencies to avoid short- and long-term adverse impacts associated with the destruction or modification of wetlands whenever possible. The state also has a coastal management plan prepared in accordance with the Coastal Zone Management Act of 1972.

Texas state boating regulations limit PWC operation to no-wake speeds within 50 feet of the shoreline.

METHODOLOGY AND ASSUMPTIONS

Potential impacts to shoreline vegetation and to the shoreline itself (erosion that can affect shoreline communities) were evaluated based on the pattern of use of motorized watercraft in Amistad Reservoir, the nature of the shoreline and vegetation present, and the professional judgment and

observations of the project team and members of the park staff. To assess the magnitude of impacts from PWC use on shoreline vegetation, the following assumptions were made:

1. Most PWC users operate their craft in a lawful manner and abide by state laws and the "Superintendent's Compendium."
2. PWC users who disembark on the shoreline would travel no more than 100 feet, staying within eyesight of their craft.
3. Impacts in 2012 would be greater than those occurring in 2002 since visitor numbers are projected to increase and PWC use is projected to increase by 1.5% per year (see Table 20).

IMPACT ANALYSIS AREA

The impact analysis area is based on areas where personal watercraft may travel within the reservoir. Topography limits use in portions of the impact analysis area. In some areas limestone cliffs rise straight out of the water, thereby limiting access to the shore. For the purposes of this evaluation, the impact analysis area includes the shoreline and a 30-foot inland area where PWC operators may land and explore the shoreline.

IMPACT TO SENSITIVE SHORELINE VEGETATION FROM PWC USE AND VISITOR TRAMPLING

Shoreline vegetation impacts were determined by examining the potential effects of PWC and visitor use on vegetation, according to type and sensitivity. The number of personal watercraft and visitors and their distribution was based on the analysis provided in the "Motorized Watercraft Use Trends" section. The following impact thresholds were established to describe the relative changes in shoreline vegetation under the alternatives being considered:

Negligible: Impacts would have no measurable or perceptible changes in plant community size, integrity, or continuity.

Minor: Impacts would be measurable or perceptible but would be localized within a relatively small area. The overall viability of the plant community would not be affected and, if left alone, would recover.

Moderate: Impacts would cause a change in the plant community (e.g., abundance, distribution, quantity, or quality); however, the impact would remain localized.

Major: Impacts to the plant community would be substantial, highly noticeable, and permanent.

Impairment: PWC use would contribute substantially to the deterioration of the shoreline or shallow water environment to the extent that the park's shoreline or submerged vegetation would no longer function as a natural system. In addition, these adverse major impacts to park resources and values would

contribute to deterioration of these resources to the extent that the park's purpose could not be fulfilled as established in its enabling legislation;

affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or

affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. PWC operators would continue to travel along the shoreline wherever motorized vessels are authorized by the present "Superintendent's Compendium." Hidden Cave Cove, Painted Canyon, and Seminole Canyon would remain closed to the public, and vessels would be prohibited from landing on islands or operating within harbors, mooring areas, and any no-wake areas marked by buoys. Numbers of personal watercraft using the reservoir during a high-use day would increase from 32 per day in 2002 to 37 per day in 2012 (see Table 20). While personal watercraft would be distributed throughout the reservoir, the primary location for potential impacts would be where PWC use is most prevalent: the San Pedro arm of the reservoir (at the end of Spur 454) and the Indian Springs area in the upper Devils River arm of the lake. Personal watercraft cannot access spring-fed creek areas, so no direct impacts would occur at these sites. Potential impacts include negligible short-term wave action and trampling caused by PWC operators landing their craft and walking on the shore.

Continued PWC use at Amistad National Recreation Area would have negligible adverse impacts to shoreline vegetation over the short and long term, with no perceptible changes in plant community size, integrity, or continuity.

Cumulative Impacts. Other motorized watercraft use Amistad Reservoir, in addition to personal watercraft. On busy summer weekends, personal watercraft account for only 8% to 20% of total boating activity; on weekdays PWC use comprises 19% to 40% of total boating activity (NPS 2002b). Numbers of motorboats using the reservoir (other than personal watercraft) during a high use day are projected to increase from 175 per day in 2002 to 213 per day in 2012, an average increase of 2% per year (see Table 20).

Fluctuating water levels create more potential for short- and long-term erosion and impacts to shoreline vegetation than any other sources, followed by wind, other motorized boats, and personal watercraft. Fluctuating water levels greatly deter the development of hydrophytic shoreline vegetative or aquatic vegetation, such as nearshore emergent plants and macrophytes, and largely prevent the growth of shoreline vegetation. Where vegetation does exist, the fluctuating water levels have caused the development of mesic-adapted exotic plant communities.

Wave action, which can cause shoreline erosion, is usually caused by winds and other nonmotorized watercraft. Park staff believe that wind affects wave action much more than personal watercraft and other motorized vessels combined. Park staff have observed PWC wakes that reach the shoreline; however, reservoir fluctuations and wind appear to be the primary causes of impacts to shoreline vegetation (J. Labadie, NPS, pers. comm., P. Steinholtz, URS, Aug. 15, 2002, scoping meeting).

Overall, PWC use and other sources of cumulative impacts would create negligible, long-term, adverse effects on the shoreline, shoreline vegetation, and aquatic plants.

Conclusion. PWC use and activities would have negligible adverse impacts over the short and long term, and there would be no perceptible changes to plant community size, integrity or continuity, now or in the future (2012).

On a cumulative basis other impact sources are more prevalent than PWC use. However, there are no obvious impacts now, and none are expected in the future, so impacts to shoreline vegetation would continue to be negligible. There would be no perceptible changes to plant community size, integrity, or continuity now or by 2012.

This alternative would not result in an impairment of shoreline vegetation.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. Under alternative B personal watercraft would continue to be allowed along the shoreline under the same restrictions as alternative A, but would be banned from the Pecos River, the Rio Grande north of buoy 28, the Devils River north of buoy P, and San Pedro Canyon east of buoy SPC-1. Other motorboats would be able to continue using these areas. Overall numbers of personal watercraft would remain the same as in alternative A, with maximum use projected to increase from 32 per day in 2002 to 37 per day in 2012. PWC impacts to shoreline vegetation would be similar to those described for alternative A, although the areas of potential impact would change. Continued PWC use in other segments would have negligible adverse impacts to sensitive shoreline vegetation over the short and long term, with no perceptible changes in plant community size, integrity, or continuity.

Cumulative Impacts. The contribution to cumulative impacts from non-PWC sources would be the same as those described for alternative A. Under alternative B there would be a negligible reduction in overall impacts caused by PWC use due to limitation on areas of their use.

Overall, PWC and other sources of cumulative impacts would create negligible, short- and long-term, adverse effects on the shoreline, shoreline vegetation, and aquatic plants. There would be no perceptible changes to plant community size, integrity or continuity, now or in the future (2012).

Conclusion. PWC use would have negligible adverse impacts over the short and long term because there are no perceptible changes to plant community size, integrity or continuity now, and none are expected in the future (2012). PWC restrictions would result in beneficial impacts to shoreline vegetation in the Pecos River, Rio Grande north of buoy 28, Devils River north of buoy P, and San Pedro Canyon east of buoy SPC-1.

On a cumulative basis other sources of impacts are more prevalent than PWC use. However, there are no obvious impacts now, and none are expected in the future, so impacts to shoreline vegetation would continue to be negligible. There would be no perceptible changes to plant community size, integrity, or continuity now or by 2012.

This alternative would not result in an impairment of shoreline vegetation.

Impacts of the No-Action Alternative — No PWC Use

Analysis. Banning PWC use within the national recreation area would eliminate any potential impacts to shoreline vegetation as a result of wave action or access gained from personal watercraft. Impacts to shoreline vegetation would be beneficial for the short and long term. No perceptible changes to plant community size, integrity, or continuity are expected now or by 2012.

Cumulative Impacts. Cumulative impacts would be similar to those described for alternative A except that PWC contribution to these impacts would be eliminated. Impacts form wind-generated waves and non-PWC motorboats would continue to have negligible adverse impacts. No perceptible changes to plant community size, integrity, or continuity, are expected now or by 2012.

Conclusion. Impacts on shoreline vegetation would be beneficial as a result of banning PWC use. There would be no perceptible changes to plant community size, integrity, or continuity now or by 2012.

Cumulative impacts from other visitor uses would continue, but are expected to be negligible in the short and long term. PWC contribution to overall vegetation impacts would be eliminated. There would be no perceptible changes to plant community size, integrity, or continuity, now or by 2012.

This alternative would not result in an impairment of shoreline vegetation.

VISITOR EXPERIENCE

Some research suggests that PWC use is viewed by some segments of the public as a nuisance due to their noise, speed, and overall environmental effects, while others believe that personal watercraft are no different from other motorcraft and that people have a right to enjoy the sport. The primary concern involves changes in noise, pitch, and volume due to the way personal watercraft are operated. Additionally, the sound of any watercraft can carry for long distances, especially on a calm day.

GUIDING REGULATIONS AND POLICIES

NPS *Management Policies 2001* state that the enjoyment of park resources and values by the people of the United States is part of the fundamental purpose of all parks and that the National Park Service is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks. Because many forms of recreation can take place outside a national park setting, the National Park Service will therefore seek to

- provide opportunities for forms of enjoyment that are uniquely suited and appropriate to the superlative natural and cultural resources found in a particular unit
- defer to local, state, and other federal agencies; private industry; and non-governmental organizations to meet the broader spectrum of recreational needs and demands that are not dependent on a national park setting

Unless mandated by statute, the National Park Service will not allow visitors to conduct activities that

- would impair park resources or values;
- would create an unsafe or unhealthful environment for other visitors or employees;
- are contrary to the purposes for which the park was established; or
- would unreasonably interfere with the atmosphere of peace and tranquillity, or the natural soundscape maintained in wilderness and natural, historic, or commemorative locations within the park; NPS interpretive, visitor service, administrative, or other activities; NPS concessioner or contractor operations or services; or other existing, appropriate park uses.

Part of the purpose of Amistad National Recreation Area is to offer opportunities for recreation, education, inspiration, and enjoyment. Its significance lies in its diverse offering of water-based recreational opportunities that visitors enjoy. One of the national recreation area's mission goals is to ensure that "visitors safely enjoy and are satisfied with the availability, accessibility, diversity, and quality of park facilities, services, and appropriate recreational opportunities." To achieve this mission goal, two long-term (five-year) visitor goals were identified in the *Strategic Plan:*

- *Visitor Satisfaction* — By September 30, 2005, 95% of visitors to Amistad National Recreation Area are satisfied with appropriate park facilities, services, and recreational opportunities.

- *Visitor Safety* — By September 30, 2005, the visitor accident/incident rate is reduced from FY1991-FY1995 five-year average (1.66 accidents/100,000 visitor days) to 1.39 accidents/100,000 visitor days, a 16% reduction.

Both goals focus on maintaining high visitor satisfaction by means of appropriate and safe recreational opportunities and experiences.

The national recreation area's enabling legislation identifies outdoor recreation and protection of scenic, scientific, cultural, and other values as important elements of the visitor experience.

METHODOLOGIES AND ASSUMPTIONS

The purpose of this impact analysis was to determine if PWC use at Amistad National Recreation Area is compatible or in conflict with the purpose of the park, its visitor experience goals, and the direction provided by NPS *Management Policies*. Thus, these policies and goals were integrated into the impact thresholds.

To determine impacts, the current level of PWC use (based on current high-use days) was calculated for segments of the recreation area (see the "PWC Use Trends" section). Other recreational activities and visitor experiences that are proposed in these locations were also identified. Visitor surveys and staff observations were evaluated to determine visitor attitudes and satisfaction in areas where personal watercraft are used. Baseline visitor survey data at Amistad National Recreation Area suggest that the majority (85%) of visitors are satisfied with their current experiences.

The potential for change in visitor experience was evaluated by identifying projected increases or decreases in both personal watercraft and other visitor uses, and determining whether these projected changes would affect the desired visitor experience and result in greater safety concerns or additional user conflicts.

IMPACT ANALYSIS AREA

In terms of PWC use, the appropriate boundary for analyzing visitor experience impacts includes all areas of Amistad Reservoir that are open to vessels, as described in the "Superintendent's Compendium." Additionally, PWC use may affect visitors at swimming areas and campgrounds near the shoreline, such that visitors within 200 feet of the shore are considered to be within the affected area.

IMPACT OF PERSONAL WATERCRAFT ON VISITOR EXPERIENCE GOALS

The following thresholds for evaluating impacts on visitor experience were defined:

Negligible: Visitors would not likely be aware of the effects associated with changes proposed for use and enjoyment of park resources.

Minor: Visitors would likely be aware of the effects associated with changes proposed for use and enjoyment of park resources; however the changes in visitor use and experience would be slight and likely short term. Other areas in the park would remain available for similar visitor experience and use without derogation of park resources and values.

Moderate: Visitors would be aware of the effects associated with changes proposed for use and enjoyment of park resources. Changes in visitor use and experience would be readily apparent and likely long term. Other areas in the park would remain available for similar visitor experience and use without derogation of park resources and values, but visitor satisfaction might be measurably affected (visitors could be either satisfied or dissatisfied). Some visitors who desire to continue their use and enjoyment of the activity/visitor experience would be required to pursue their choice in other available local or regional areas.

Major: Visitors would be highly aware of the effects associated with changes proposed for use and enjoyment of park resources. Changes in visitor use and experience would be readily apparent and long term. The change in visitor use and experience proposed in the alternative would preclude future generations of some visitors from enjoying park resources and values. Some visitors who desire to continue their use and enjoyment of the activity / visitor experience would be required to pursue their choices in other available local or regional areas.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. PWC operators under alternative A would have unrestricted use within Amistad reservoir (except where currently restricted by the "Superintendent's Compendium"), increasing from an average high of 32 personal watercraft per day within the reservoir boundary to 37 (see Table 20).

Impacts on PWC Users — There would be no change to PWC use or activity as compared to existing conditions. Alternative A would have no effect on the experiences of PWC users at Amistad National Recreation Area.

Impacts on Other Boaters — Other boaters to Amistad National Recreation Area would continue to interact with PWC operators. Generally, few nonmotorized craft use Lake Amistad (sea kayaks and canoes), so interactions with these user groups are infrequent. Motorboats are more likely to interact with personal watercraft. There are three locations with the potential for boat/PWC interactions: near the Spur 454 boat ramp, on the Devils River upstream from the Rough Canyon boat ramp, and directly in front of the Diablo East harbor. Although no accidents or conflicts have been documented in these areas, the potential exists (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 11, 2002, re: boats and PWC). Based on this analysis, alternative A would have negligible adverse effects on the visitor experience of other boaters for the existing and future conditions.

Impacts on Other Visitors —Swimmers, hikers, and other visitors would have contact with PWC users. San Pedro Canyon is a popular PWC destination, and new unofficial swim beaches in this area have become very popular on weekends, with as many as 60 swimmers at one beach (see the "Affected Environment"). On July 4, 2001 a high of 14 PWC trailers were counted at Spur 454, which serves the San Pedro area. Boat ramps at Diablo East and 277 North also serve the San Pedro Canyon. PWC use would have moderate adverse effects on swimmers in San Pedro Canyon.

Receding lake levels have led to decreased visitation to park campgrounds. Because campgrounds are currently high above the lake level, contact between campers and PWC users is low. However, lake levels could rise, camping visitation could increase, and contact between the two groups could increase. PWC use would have negligible to minor adverse effects on visitors to park campgrounds and minor adverse effects at higher water levels.

Boaters often camp along the shoreline (outside park campgrounds) and may be affected by PWC use. However, because these unofficial campsites are located along the shore, campers would be exposed to motorized boat use as well as PWC use. It is likely that these campers move on after spending the

night, and since PWC use is restricted to the hours between sunrise and sunset, they would experience little contact with PWC users. PWC use would have negligible adverse effects to these campers.

Cumulative Impacts. The primary activities at Amistad National Recreation Area that may affect visitor experiences include the number and activities of other visitors, and noise from motorboats. No other actions are currently planned that would affect PWC use or visitor experiences within the national recreation area. According to a 2001 visitor survey, most visitors are satisfied with their experiences at the park. Cumulative impacts related to the use of personal watercraft, motorized boats, and other visitor activities would be negligible over the short and long term because there would be little noticeable change in visitor experiences, even with projected PWC and boat use increases.

Conclusion. Continued PWC use at Amistad National Recreation Area would have negligible adverse impacts on experiences for most visitors in the short and long term. PWC use would have long-term, negligible, adverse impacts on shoreline campers, but long-term, minor adverse impacts on swimmers and other visitors using official park campgrounds and desiring an experience characterized predominantly by natural quiet. When related to other visitor activities, PWC use would not appreciably limit the critical characteristics of visitor experiences.

Cumulative effects of PWC use, other watercraft, and other visitors would continue to result in long-term, negligible to minor, adverse impacts, since there would be little noticeable change in visitor experiences. Most visitors would continue to be satisfied with their experiences at Amistad National Recreation Area.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. PWC users under alternative B would be restricted from operating east of buoy SPC-1 in San Pedro Canyon, north of buoy P in the Devils River, north of buoy 28 in the Rio Grande, and in the entire Pecos River. The Devils River closure would affect PWC users launching from the Rough Canyon boat ramp (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 1, 2002; re: water and use), which accommodates approximately 50% of the personal watercraft operating in the reservoir during peak use (based on PWC trailer counts at Amistad launch sites). The San Pedro Canyon closure would also affect most PWC users launching from the Spur 454 ramp (approximately 5–10 of the average 32 PWC operating during peak-use days). In addition, some PWC users who launch from the Diablo East ramp also access the San Pedro area, and they would be impacted by the San Pedro closure (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 1, 2002, re: water and use). The Pecos River closure would not impact PWC users, because this area sees little use. Few PWC users access the Rio Grande north of buoy 28, but approximately a third to a half of the PWC recreationists who launch from Diablo East are associated with rental houseboats, many of which go to the Rio Grande part of the reservoir.

Impacts on PWC Users — By prohibiting PWC use in the San Pedro Canyon, parts of the Devils River and Rio Grande, and entire Pecos River, the park believes that most of the current PWC users would continue to visit Amistad and would be redistributed into other areas of the lake. PWC would likely concentrate in Castle Canyon and the Devils River from its mouth up to buoy P. PWC operators who launch at the Rough Canyon boat ramp may refuse to return to Amistad, but this would constitute approximately 10% of these boat ramp users (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 7, 2002; re: water quality). Many PWC users would perceive a noticeable change in their visitor experiences or visitor satisfaction, since two popular PWC destinations (Indian Springs on the Devils River and San Pedro Canyon) would be closed to PWC use. However, PWC users could easily be

accommodated in other areas of the reservoir. Under this alternative visitors who use personal watercraft at Amistad would experience minor to moderate adverse impacts.

Impacts on Other Boaters — Other boaters at Amistad National Recreation Area would continue to interact with PWC operators. The most common areas for PWC and boater interaction are at the Spur 454 boat ramp, the Diablo East harbor, and Devils River upstream from the Rough Canyon boat ramp. A reduction in PWC use could be anticipated at the Spur 454 boat ramp due to the San Pedro Canyon closure. Based on this analysis, alternative B would decrease the number of PWC operators in Devils River and San Pedro Canyon, a possible benefit to other boaters. Closing the Pecos River and Rio Grande north of buoy 28 would result in negligible adverse impacts to other boaters, because these areas are infrequently accessed by PWC users. Other boaters would experience beneficial effects throughout the recreation area, due to continued PWC use redistributed throughout the park.

Impacts on Shoreline Visitors — Swimmers, hikers, and other visitors to the San Pedro Canyon and upper Devils River areas would have less contact with PWC operators than under alternative A due to restricted PWC access in those areas. The decreased amount of contact would be noticeable in comparison to existing conditions, especially at the unofficial swim beaches at the Spur 454 San Pedro Cliffs area, the peninsula across the road from Spur 454, and Horseshoe Cliffs. However, the swimmer population has been decreasing due to low lake levels. Swimmers may experience beneficial effects. Other visitors who picnic, birdwatch, camp, and walk near the roads that access boat ramps for San Pedro Canyon and Diablo East would experience a reduction in PWC use in those areas, resulting in beneficial impacts to non-PWC users.

Cumulative Impacts. Motorized boats and other visitors would continue to interact with PWC users, with negligible adverse impacts. Cumulative impacts related to the use of personal watercraft, motorized boats, and other visitor activities would be negligible over the short and long term because PWC use would be restricted from popular swimming areas, as well as some areas where potential conflicts exist, but would be redistributed throughout the rest of the reservoir. Most visitors would continue to be satisfied with their experiences at Amistad National Recreation Area.

Conclusion. Continued PWC use at Amistad National Recreation Area would have negligible adverse impacts on the experiences of most visitors in the short and long term. PWC restrictions at San Pedro Canyon and upper Devils River would have beneficial impacts on swimmers and those visitors who desire natural quiet. The level of PWC use would remain approximately the same, but would be redistributed throughout the reservoir.

Cumulative effects of PWC use, other watercraft, and other visitors would continue to result in long-term, negligible, adverse impacts. Most visitors would continue to be satisfied with their experiences at Amistad National Recreation Area.

Impacts of the No-Action Alternative — No PWC Use

Analysis. PWC use would no longer be allowed at Amistad National Recreation Area.

Impacts on PWC Users — Based on current PWC use estimates, approximately 32 personal watercraft are used at Amistad on a high-use day; assuming 1.5 riders per machine, this amounts to 48 people per day. Under the no-action alternative, these people would no longer be allowed to participate in this form of recreation in the national recreation area. Based on current use projections, by 2012 approximately 56 PWC riders on 37 watercraft would not be able to enjoy this experience in the national recreation area. This number would continue to be a small percentage of daily peak visitation.

Discontinuing PWC use would not necessarily preclude a visit to the reservoir by PWC owners. Park staff expect that approximately 85% of PWC users would continue to visit Amistad and take part in some other form of recreation, such as boating or fishing (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Oct. 2, 2002; re: PWC visitation). Current PWC users could still use a motorboat or other watercraft and could continue to experience activities such as hiking, sightseeing, and camping. The level of impact to PWC users is expected to be moderate adverse for the short and long term, since the number of visitors using personal watercraft would be altered. However, former PWC users would not be precluded from experiencing the reservoir through other recreational activities, and it is not expected that visitation would substantially decrease.

Impacts on Other Boaters — Banning PWC use within Amistad National Recreation Area would eliminate interactions between other boaters and PWC operators. While there are no documented incidents involving a PWC user and other boaters at Amistad National Recreation Area, there are reported complaints, and it is assumed that this alternative would eliminate any possible conflicts between various uses within the reservoir. Other boaters would not have to watch for or come into conflict with PWC users, thus resulting in a beneficial impact on other watercraft users.

Impacts on Other Shoreline Visitors — Restricting PWC use within the national recreation area would have a beneficial effect on users such as swimmers, hikers, birdwatchers, picnickers, and sightseers.

In summary, a small number of PWC operators would experience moderate adverse effects while a large number of other users would experience beneficial effects. Based on this qualitative analysis, the no-action alternative would result in a beneficial effect on visitor experiences for both the short and long term.

Cumulative Impacts. The cumulative impacts for the no-action alternative would be beneficial as compared to alternative A. The visitor experience of non-PWC users would be beneficial because there would be no conflicts with or intrusions from PWC users within the park's jurisdiction. Conversely, the visitor experience of PWC users would be adversely affected because of these same restrictions. Most visitors would continue to be satisfied with their experiences at Amistad National Recreation Area. On a regional basis the no-action alternative would result in a negligible adverse effect to PWC activities on other waterbodies in the state as a result of PWC users going to other locations to enjoy this activity.

Conclusion. The no-action alternative would have a beneficial impact on the experiences of most visitors because PWC use would be banned. Impacts on PWC users who would no longer be able to ride in the national recreation area would be long term, moderate, and adverse.

Cumulative impacts would be beneficial as compared to alternative A. Most visitors would continue to be satisfied with their experiences at Amistad National Recreation Area. On a regional scale the no-action alternative would result in a negligible adverse effect to other waterbodies in the state as a result of PWC users going to other locations to enjoy this activity.

VISITOR CONFLICTS AND SAFETY

Industry representatives report that PWC accidents decreased in some states in the late 1990s. The National Transportation Safety Board reported that in 1996 personal watercraft represented 7.5% of state-registered recreational boats but accounted for 36% of recreational boating accidents. In the same year PWC operators accounted for more than 41% of the people injured in boating accidents. PWC operators accounted for approximately 85% of the persons injured in accidents studied in 1997 (NTSB

1998). Few PWC accidents have been reported at Amistad National Recreation Area, and there have been some incident reports, most involving PWC users and swimmers or other boaters. Staff receive infrequent calls for assistance in locating a PWC operator who is overdue or "missing." Running out of gas is also a concern and may be hazardous because of the vast size of the park. The park does not have regular boat patrols, which would be necessary to better identify PWC/visitor safety issues.

Divers may be present within the recreation area at submerged ranch home locations. No conflicts between PWC users and divers have been observed. Divers set buoys to identify their location, so PWC users should be able to avoid these areas and any resulting conflicts.

PWC speeds, wakes, and operations near other users can pose hazards and conflicts, especially to canoeists and sea kayakers. Currently very few nonmotorized boats are used in the national recreation area, but conflicts could occur with personal watercraft, particularly if PWC use increased as predicted. To date, few conflicts have been reported.

GUIDING REGULATIONS AND POLICIES

In addition to the guiding regulations and policies discussed in the "Visitor Experience" section, the NPS *Management Policies 2001* state that the National Park Service is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks. The policies also state, "While recognizing that there are limitations on its capability to totally eliminate all hazards, the Service and its concessioners, contractors, and cooperators will seek to provide a safe and healthful environment for visitors and employees" (sec. 8.2.5.1). Further, the National Park Service will strive to protect human life and provide for injury-free visits (sec. 8.2.5).

The safe use of personal watercraft is promoted and defined by the Texas Water Safety Act, which is defined in the "Affected Environment." This act provides rules for use, safety requirements, and duties and responsibilities concerning PWC operation, beginning on page 74.

METHODOLOGY AND ASSUMPTIONS

The methodology for visitor conflicts and safety is similar to that used for visitor experience. The potential visitor-related impacts attributable to personal watercraft — a higher rate of accidents than for other watercraft, conflicts with other park users, negative effects on some types of visitor experiences — could potentially affect the NPS policy to provide for injury-free visits. Potential impacts were identified based on the number and activities of personal watercraft operating within the area, the number and activities of other visitors in an area, and the proximity of these user groups.

It is assumed that Texas PWC regulations are enforced within the national recreation area. These regulations govern PWC activities near the shore, the timing of use, and the age and educational requirements of operators.

IMPACT ANALYSIS AREA

In terms of visitor safety, the appropriate boundary for analyzing impacts includes the entire U.S. side of Amistad Reservoir (57,292 acres), except where PWC use is already prohibited by the "Superintendent's Compendium." The boundary continues 74 miles northwest up the Rio Grande, 25 miles north up the Devils River, and 14 miles north up the Pecos River. Additionally, PWC use may affect visitors

at beaches and campgrounds near the shoreline, such that visitors within 200 feet of the shore are considered to be within the affected area.

IMPACT OF PWC USE AND CONFLICTING USES ON VISITOR SAFETY

The impact intensities for both visitor conflicts and safety follow. Where impacts to visitor experience or visitor safety become moderate or minor, it is assumed that current visitor satisfaction and safety levels would begin to decline and the park would not be achieving some of its long-term visitor goals.

Negligible: The impact to visitor safety would not be measurable or perceptible.

Minor: The impact would be measurable or perceptible, but it would be limited to a relatively small number of visitors at localized areas. Impacts to visitor safety could be realized through a minor increase or decrease in the potential for visitor conflicts in current accident areas.

Moderate: The impact to visitor safety would be sufficient to cause a permanent change in accident rates at existing low accident locations or to create the potential for additional visitor conflicts in areas that currently do not exhibit noticeable visitor conflict trends.

Major: The impact to visitor safety would be substantial either through the elimination of potential hazards or the creation of new areas with a high potential for serious accidents or hazards.

Impacts of Alternative A —— Continue PWC Use under a Special NPS Regulation

Analysis. This alternative assumes that PWC operations would continue the same as existing conditions, increasing from an average high use of 32 personal watercraft on a peak day to 37 by 2012 (see Table 20).

PWC Users / Swimmer Conflicts — In 10 years it is estimated that 37 personal watercraft would be in use in the reservoir during peak use days. The number of swimmers at the reservoir has been decreasing with reductions in lake levels, which has lead to the creation of several unofficial swim beaches.

The greatest potential for conflict with swimmers is near Diablo East and San Pedro Canyon. This is where many of the park's visitors swim, and it includes popular PWC boat launches. Buoys warning motorized watercraft to keep out of the official swim areas were vandalized, and PWC users occasionally enter these areas. Of the five official swim beaches, all but one are in the area of Diablo East or San Pedro Canyon. Most currently experience little to no use due to low lake levels (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 11, 2002, re: swimmers).

Of the three new unofficial swim beaches, one is also popular with PWC users. All are located in the San Pedro Canyon area. A total of approximately 80 to 120 swimmers use these beaches on busy summer weekend days. An estimated 20 to 25 personal watercraft are launched in this area during peak use days. The potential exists for an accident involving a swimmer, particularly if lake levels rise and swimmer visitation increases to previous levels. Due to the number of visitors involved, impacts at this location are predicted to be moderate adverse.

The remaining reservoir locations would have little or no conflict between PWC users and swimmers because official and unofficial swim beaches are concentrated in the Diablo East and San Pedro Canyon areas. There is one official swim beach at Rough Canyon, but the swim area currently has no

water due to low lake levels. Thus, conflicts in other areas would constitute negligible, adverse impacts over the short and long term.

Overall, PWC use would continue to have minor adverse impacts on swimmers at Amistad National Recreation Area. Impacts would be perceptible to a relatively small number of visitors at localized areas, primarily at San Pedro Canyon where the unofficial beaches exist.

PWC Users / Other Boater Conflicts — Other motorized watercraft are distributed throughout the reservoir. Their use patterns are not exactly the same as those for personal watercraft, but the two groups do use the same areas. Motorboats are concentrated in the Castle Canyon area, the Devils River area between the Devils Shores subdivision and Indian Springs, and the area in front of Amistad Dam. The same launch ramps that are popular with PWC users are also popular with motorboaters. The Spur 454 boat ramp, Devils River upstream of the Rough Canyon boat ramp, and the area in front of the Diablo East harbor have the most potential for conflicts between PWC users and motorboaters. These three launch areas experience the highest visitor use. Traffic gets congested in these areas, which increases the risk of collision and the potential for conflicts. Because both motorized boat and PWC use are projected to increase each year (2% and 1.5% respectively), the potential for conflicts could increase in this area, resulting in minor to moderate adverse impacts.

The remaining areas of the reservoir would experience negligible conflicts between PWC users and other motorboaters, due to the small number of watercraft being launched at these areas.

Overall, PWC use would continue to have minor adverse impacts on other motorized boat users at Amistad National Recreation Area. Impacts would be perceptible to visitors at localized areas, primarily at Spur 454, Devils River upstream of Rough Canyon, and the Diablo East harbor. Conflicts at other locations would remain negligible because use is lower, and conflicts would be less likely to occur.

Cumulative Impacts. The Amistad shoreline is used by a variety of visitors, including swimmers, motorboaters, kayakers, and canoeists. All of these user groups interact with each other and occasionally come into conflict. Use is concentrated in some areas of the reservoir, but more distributed in other areas. Projected increases in both motorized boat and PWC use (2% and 1.5% respectively) could cause further congestion in these areas. For this reason, the cumulative impact on visitor conflicts and safety would be minor to moderate over the short and long term, depending on the user group. Cumulative impacts in other segments would be negligible because of infrequent use.

Conclusion. Continued PWC use would have short- and long-term, minor to moderate adverse impacts on visitor conflicts and safety in the areas near Spur 454, the Devils River upstream of Rough Canyon, and in front of the Diablo East harbor due to the number of visitors and boats present on high use days. Conflicts at other locations would remain negligible because use is lower, and conflicts would be less likely to occur.

Cumulative impacts related to visitor conflicts and safety would be minor to moderate for all user groups in the short and long term, particularly near the three areas listed above. Cumulative impacts in other segments would be negligible because of reduced use.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. Under this alternative PWC operations would continue the same as existing conditions, except that use would be prohibited in the Pecos River, San Pedro Canyon, the northern section of Devils River, and the northern section of the Rio Grande. As a result, PWC users who normally operate in these restricted areas would have to relocate to other parts of the reservoir, particularly Castle Canyon and the southern area of the Devils River.

PWC Users / Swimmer Conflicts — PWC user / swimmer interactions would decrease in the San Pedro segment (where the new unofficial swim beaches exist) because PWC use would be prohibited there. No conflicts would occur in the San Pedro segment, resulting in a beneficial impact to swimmers. The park estimates that approximately 10% of PWC users who launch from Rough Canyon would discontinue visiting Amistad (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 1, 2002, re: water and use). In the remaining reservoir locations there would be little or no conflict between PWC users and swimmers, resulting in a beneficial impact to swimmers.

Overall, restricted PWC use would have beneficial impacts on most swimmers at Amistad National Recreation Area, primarily in the San Pedro segment. Impacts would be perceptible to a relatively small number of visitors (approximately 80–120 swimmers at the unofficial beaches) at localized areas.

PWC Users / Other Boater Conflicts — Impacts regarding the potential for use conflicts near Spur 454 and the Diablo East harbor would be similar to alternative A. However, little to no conflict would exist between PWC users and boaters on the Devils River upstream from the Rough Canyon boat ramp because personal watercraft would be restricted north of buoy P on the Devils River. Currently, approximately 14 personal watercraft and 57 boats are launched at Rough Canyon on high-use days (e.g., September 1, 2001, a holiday weekend). The majority (90%) of PWC users who launch at Rough Canyon would be redistributed to other launch areas in the general area, most likely Diablo East or Spur 454. In addition, alternative B would close two boat ramps in San Pedro Canyon to PWC use, the 277 North and South ramps; however, these ramps currently experience little to no PWC use. These combined restrictions would likely increase the number of watercraft launching from Diablo East and Spur 454 locations, which are already identified as having conflict potential. However, the increase would be small (approximately 12 personal watercraft on high-use days), and the closure of the northern part of the Devils River would result in reduced potential for conflicts in that area. PWC use would likely be redistributed to Castle Canyon, an area where motorboats concentrate, with a potential for increased interactions (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Sept. 7, 2002). Conflicts would be eliminated in the Pecos River, but this area has experienced very little PWC use. Therefore, PWC use would have minor to moderate adverse impacts on other motorized boat users at Amistad National Recreation Area.

Cumulative Impacts. Cumulative impacts would result in PWC users launching from more concentrated areas, such as Diablo East, providing a beneficial impact to swimmers and a possible adverse impact to other boaters due to increased congestion at launch areas. The cumulative impact of the various user groups on visitor conflicts and safety would be beneficial for swimmers and possibly minor adverse for other boaters over the short and long term. Cumulative impacts in other segments would remain negligible.

Conclusion. Continued PWC use would have short- and long-term, minor, adverse impacts on visitor conflicts and safety. Swimmers in the San Pedro area would experience beneficial impacts, while other

boaters would experience negligible adverse impacts due to increased congestion at popular boat launch areas and the redistribution of PWC use. Conflicts at other locations would remain negligible because use is lower and conflicts would be less likely to occur. Conflicts would be eliminated in the Pecos River, resulting in beneficial impacts.

Cumulative impacts related to visitor conflicts and safety would be minor to moderate for all user groups in the short and long term, particularly in the Diablo East and San Pedro areas. Cumulative impacts in other segments would remain negligible.

Impacts of the No-Action Alternative — No PWC Use

Analysis. Under the no-action alternative all PWC use would be banned, eliminating any conflicts between PWC operators and other visitors. No swimmer / PWC incidents would occur. This would be a beneficial impact.

Cumulative Impacts. Cumulative impacts would be similar to those described for alternative B, except PWC use would be totally eliminated. Overall, conflicts and safety would improve because eliminating PWC use within the recreation area would remove the potential for conflicts between PWC users, swimmers, or other boaters. Cumulative impacts to visitor conflict and safety would be reduced to negligible adverse. Even without PWC use, increased boat use around the high-use boat ramps, such as Diablo East, could result in a greater potential for visitor conflicts and safety hazards.

Conclusion. Discontinuing PWC use would result in beneficial impacts by reducing visitor conflicts and enhancing safety.

PWC-related contributions to overall cumulative impacts to visitor safety would be eliminated. Visitor safety impacts from other sources would be negligible.

CULTURAL RESOURCES

GUIDING REGULATIONS AND POLICIES

The National Park Service's primary interest in cultural resources — archeological resources and districts, historic structures and districts, cultural landscapes, ethnographic resources, and museum collections — stems from its responsibilities under the following legislation:

The NPS Organic Act — responsibility to conserve the natural and historic objects within parks unimpaired for the enjoyment of future generations

National Historic Preservation Act — responsibility to preserve, conserve, and encourage the continuation of the diverse traditional prehistoric, historic, ethnic, and folk cultural traditions that underlie and are a living expression of our American heritage

American Indian Religious Freedom Act — responsibility to protect and preserve for American Indians access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites

Archeological Resources Protection Act — responsibility to secure, for the present and future benefit of the American people, the protection of archeological resources and sites that are on public lands

Executive Order 13007 — responsibility to (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, and (2) avoid adversely affecting the physical integrity of such sacred sites.

In accordance the *Management Policies 2001*, the National Park Service must be respectful of ethnographic resources and carefully consider the effects that NPS actions may have on them (sec. 5.3.5.3). Specific guidance for the management of cultural resources for the National Park Service is provided in *NPS-28: Cultural Resource Management Guideline* (NPS 1997a).

ASSUMPTIONS AND METHODOLOGIES

In this environmental assessment impacts to cultural resources are described in terms of type, context, duration, and intensity, which is consistent with the CEQ regulations. Historic structures, cultural landscapes, ethnographic resources, and museum collections have been dismissed from further analysis for reasons given in the "Purpose of and Need for Action" (see page 20). The following impact analyses are intended to also comply with the requirements of section 106 of the National Historic Preservation Act (36 CFR Part 800, "Protection of Historic Properties"). In accordance with the Advisory Council on Historic Preservation's regulations implementing section 106, impacts on cultural resources were identified and evaluated by:

1. Determining the area of potential effects;
2. Identifying cultural resources present in the area of potential effects that were either listed on or eligible to be listed on the National Register of Historic Places;
3. Applying the criteria of adverse effect to affected cultural resources either listed on or eligible to be listed on the National Register; and
4. Considering ways to avoid, minimize or mitigate adverse effects.

Under the advisory council's regulations, a determination of either adverse effect or no adverse effect must be made for affected, national register eligible cultural resources.

> An adverse effect occurs whenever an impact alters, directly or indirectly, any characteristic of a cultural resource that qualifies it for inclusion on the national register. Examples include diminishing the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association. Adverse effects also include reasonably foreseeable effects that would occur later in time, be farther removed in distance, or be cumulative (36 CFR 800.5).
>
> A determination of no adverse effect means there may be an effect, but the effect would not diminish in any way the characteristics of the cultural resource that qualify it for inclusion in the National Register.

The CEQ regulations and DO #12 and its handbook call for a discussion of the appropriateness of mitigation, as well as an analysis of how effective the mitigation would be in reducing the intensity of a potential impact (e.g., reducing the intensity of an impact from major to moderate or minor). Any resultant reduction in intensity of impact due to mitigation, however, is an estimate of the effectiveness of mitigation under the National Environmental Policy Act only. It does not suggest that the level of effect as defined by section 106 is similarly reduced. Although adverse effects under section 106 may be mitigated, the effect remains adverse.

A section 106 summary is included in the impact analysis section and is intended to meet the requirements of the National Historic Preservation Act. It also is intended to provide an assessment of the

effect of implementing the alternatives on cultural resources, based on the criteria found in the advisory council's regulations.

IMPACT ANALYSIS AREA

The impact analysis area is based on areas where personal watercraft may travel within the reservoir. Topography limits use in portions of the area; in some areas limestone cliffs rise straight out of the water, thereby limiting access to the shore. For the purposes of this evaluation, the impact analysis area includes the shoreline and a 200-foot inland area where PWC operators may land and explore the shoreline but remain in sight of their personal watercraft.

ARCHEOLOGICAL SITES AND SUBMERGED CULTURAL RESOURCES

Certain important research questions about human history can only be answered by the actual physical material of cultural resources. Archeological resources have the potential to answer, in whole or in part, such research questions. An archeological site can be eligible to be listed on the National Register of Historic Places if the site has yielded, or may be likely to yield, information important in prehistory or history.

Negligible: The impact would be at the lowest levels of detection or barely measurable, with no perceptible consequences, either adverse or beneficial, to archeological resources. For purposes of section 106, the determination of effect would be *no adverse effect*.

Minor: Adverse impact — The disturbance of a site would be confined to a small area with little, if any, loss of important information potential. For purposes of section 106, the determination of effect would be *no adverse effect*.

Beneficial impact — A site would be preserved in its natural state. For purposes of section 106, the determination of effect would be *no adverse effect*.

Moderate: Adverse impact — Disturbance of a site would not result in a substantial loss of important information. For purposes of section 106, the determination of effect would be *adverse effect*.

Beneficial impact — The site would be stabilized. For purposes of section 106, the determination of effect would be *no adverse effect*.

Major: Adverse impact — Disturbance of a site would be substantial and would result in the loss of most or all of the site and its potential to yield important information. For purposes of section 106, the determination of effect would be *adverse effect*.

Beneficial impact — There would be active intervention to preserve the site. For purposes of section 106, the determination of effect would be *no adverse effect*.

Impairment: A major, adverse impact to a resource or value whose conservation is

necessary to fulfill specific purposes identified in the park's establishing legislation;

key to the natural or cultural integrity of the park; or

identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. PWC use would continue within Amistad National Recreation Area with no locational restrictions. PWC users would continue to have access to archeological and submerged cultural resources under this alternative. Four national historic districts within the national recreation area are listed on the National Register of Historic Places; additional sites are located outside the districts. Not all identified sites have been formally evaluated for national register eligibility.

The most likely impact to archeological and submerged cultural sites would result from PWC users landing in areas otherwise inaccessible to most other visitors and illegally collecting or damaging artifacts. According to park staff, looting and vandalism of cultural resources is not a substantial problem. A direct correlation of impacts attributed to PWC users is difficult to draw, since many of these areas are also accessible to hikers or other watercraft users. Under this alternative the low number of PWC users within the national recreation area would have only minor adverse impacts on potentially listed archeological resources.

Continuing PWC use under a special regulation is not expected to negatively affect the overall condition of cultural resources because project-by-project inventories and mitigation would still be conducted. However, without a systematic monitoring program and given the potential access concerns, there would continue to be a risk of some unavoidable adverse impacts.

Cumulative Impacts. PWC users, other boaters, and land-based user groups would continue to have access to remote areas with potentially listed archeological sites, submerged cultural resources, and ethnographic resources. On a cumulative basis all visitor activities could result in minor to moderate adverse impacts on those resources that are readily accessible, due to the number of visitors and potential for looting and vandalism. Resources that are located in more remote areas, which are not as readily accessible to visitors, would likely still experience minor adverse impacts on a cumulative basis. All impact levels would continue at existing levels.

Conclusion. PWC use within the national recreation area could have minor adverse impacts on potentially listed archeological sites and submerged resources from possible illegal collection and vandalism.

Cumulative impacts on archeological and submerged cultural resources that are readily accessible could be minor to moderate adverse, due to the number of visitors and the potential for illegal collection or destruction.

Implementation of this alternative would not result in an impairment of cultural resources.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. PWC use would continue within the reservoir but would be banned from the Pecos River, the Rio Grande north of buoy 28, the Devils River north of buoy P, and San Pedro Canyon east of buoy SPC-1 (see alternative B map).

Impacts to archeological and submerged cultural resources would be similar to those under alternative A. No PWC-related impacts would occur within the areas closed to such use. Under this alternative the low number of PWC users within the recreation area would have only minor adverse impacts on potentially listed archeological resources. Prohibiting PWC use within the Pecos River, the Rio

Grande north of Buoy 28, the Devils River north of buoy P, and San Pedro Canyon east of buoy SPC-1 could have long-term, beneficial impacts on potentially listed archeological sites.

Cumulative Impacts. Other motorized watercraft would be able to continue using the areas closed to PWC use. On a cumulative basis all visitor activities could result in minor to moderate adverse impacts on those cultural resources that are readily accessible, due to the number of visitors and the potential for looting and vandalism. Resources in more remote areas that are not as readily accessible to visitors would likely still experience minor adverse impacts on a cumulative basis. All impacts would continue at existing levels, with lower impacts in the Pecos River, the Rio Grande north of buoy 28, the Devils River north of buoy P, and San Pedro Canyon east of buoy SPC-1 due to the exclusion of PWC use.

Conclusion. PWC use in the non-excluded segments could have minor adverse impacts on potentially listed archeological sites and submerged resources from possible illegal collection and vandalism. There would be a beneficial impact on those resources in the Pecos River, the Rio Grande north of buoy 28, the Devils River north of buoy P, and San Pedro Canyon east of buoy SPC-1, where PWC use would be discontinued.

Cumulative impacts of other activities on archeological and submerged cultural resources that are readily accessible could be minor to moderate adverse, due to the number of visitors and the potential for illegal collection or destruction.

Implementation of this alternative would not result in an impairment of cultural resources.

Impacts of the No-Action Alternative — No PWC Use

Analysis. Under this alternative PWC use would be discontinued.

Implementation of the no-action alternative would result in minor beneficial impacts on archeological sites and submerged cultural resources by reducing the potential for illegal collection or damage attributable to PWC users.

Cumulative Impacts. Even without the potential for PWC users to access remote areas, the effects of other watercraft users and land-based user groups would still have the potential for minor to moderate adverse cumulative impacts. On a cumulative basis potential visitor impacts from illegally collecting or damaging resources that are readily accessible would continue. Resources that are located in more remote areas, which are not as readily accessible to park visitors, would likely still experience minor adverse impacts, but to a lesser degree.

Conclusion. Prohibiting PWC use would have minor beneficial impacts on archeological sites and submerged resources.

Cumulative impacts from all visitor activities would continue to be minor to moderate, depending on the accessibility of the resource and the potential for illegal collection or damage.

Implementation of this alternative would not result in an impairment of cultural resources.

SECTION 106 SUMMARY

This draft environmental assessment provides detailed descriptions of three alternatives (including a no-action alternative) and analyzes the potential impacts associated with possible implementation of each alternative. The analysis of potential impacts of personal watercraft at Amistad National Recreation Area also considered access by other types of watercraft.

Visitors access the national recreation area by many modes of transportation, including motor vehicles, all types of boats, and personal watercraft, as well as by foot. Because there are so many modes of access, the impacts on archeological and submerged cultural resources directly attributable to PWC users are difficult to define. Under alternative B negligible to minor benefits to archeological resources could result from closing San Pedro Canyon, the Pecos River, and the upper sections of the Devils River and Rio Grande to PWC use. This would constitute a "no adverse effect" on archeological resources.

No-wake zones that are required by Texas state law within 50 feet of the shore and that would apply under alternatives A and B would slow damage to a few vulnerable archeological resources that are partially submerged, or that are being exposed due to receding lake levels. Because personal watercraft are small and displace little water, wakes caused by them make up an extremely small part of the lake wave action. Thus, beneficial impacts of no-wake zones defined by Texas state law and outlined in alternatives A and B would be slight, resulting in no adverse effects from this source under either alternative.

To help reduce impacts on cultural resources, resources would continue to be monitored on a regular basis. Vulnerable resources listed on or potentially eligible for the national register would have priority for protective measures. During periods of draw-down and potential exposure of vulnerable submerged archeological resources, appropriate management actions would be implemented.

In cases where it was determined there was a potential for adverse impacts to cultural resources listed on or eligible for listing on the National Register of Historic Places, the National Park Service would coordinate with the Texas state historic preservation officer to determine the level of effect on the property and the needed mitigation measures.

Pursuant to 36 CFR 800.5 (revised effective January 2001), the National Park Service finds that the implementation of any alternative being considered for PWC use at Amistad National Recreation Area, with identified mitigation measures, would not result in any new adverse effects (no adverse effect) to archeological resources currently identified as eligible for or listed on the National Register of Historic Places.

SOCIOECONOMIC EFFECTS

This section summarizes the socioeconomic impacts associated with the proposed alternatives for PWC use in Amistad National Recreation Area. A detailed description of these impacts and a complete list of references is provided in the report "Economic Analysis of Personal Watercraft Regulations in Amistad National Recreation Area" (LAW et al. 2002).

BENEFIT-COST ANALYSIS

The purpose of a benefit-cost analysis is to determine whether a proposed alternatives (in this case, the regulation of PWC use at Amistad National Recreation Area) would generate more benefits than costs. These costs and benefits accrue directly to households that use personal watercraft, and indirectly to those who are affected by PWC use (e.g., those who would benefit from reduced noise). The resulting changes in PWC use could also impose costs on those who own or work for PWC-related businesses.

Even individuals who do not visit this national recreation area could benefit from the knowledge that resources were being protected and preserved. Evidence of "nonuse" values for resources like those at Amistad has been established in the economic literature (Pearce and Moran 1994). Restrictions on PWC use could therefore provide benefits to both users and nonusers in a number of ways by protecting the national recreation area's ecological and other resources.

Under alternative A there would be no change in welfare for any visitors relative to current conditions because PWC use would continue to be allowed in accordance with current regulations.

Alternative B would positively affect all visitors and the general public, with the exception of some PWC operators and those businesses involved with PWC sales and service. Under this alternative PWC use would be restricted from San Pedro Canyon east of buoy SPC-1, the Devils River north of buoy P, the Rio Grande north of buoy 28, and the entire Pecos River. Park staff estimate that the restrictions proposed under alternative B would slightly reduce PWC sales, rentals, and other PWC-related business revenues relative to baseline conditions. Alternative B is not likely to substantially change the pattern of PWC use between Amistad and waters outside the national recreation area.

Under the no-action alternative beneficial impacts for all park visitors and the general public are expected except for PWC users and the businesses that cater to them. PWC users, PWC dealerships, and other businesses that provide services to PWC users are expected to be adversely affected. The adverse impacts of PWC use on anglers, swimmers, canoeists, and other users within Amistad would be greatly reduced as a result of prohibiting PWC use. In addition, banning personal watercraft in the park would have positive impacts on other boaters' because of the reduced probability of accidents between boaters and PWC users and decreased noise levels. However, there is some overlap between people who use personal watercraft and those who use other types of boats. Users of houseboats, powerboats, and other non-PWC boats who might enjoy using personal watercraft as part of their boating trips could be adversely affected as a result of the ban.

COSTS TO PWC USERS

Two main groups of PWC users may be affected by the proposed regulations: those who currently ride at Amistad and those in areas outside the park who could be affected by PWC users displaced from Amistad.

PWC users in nearby areas would be affected if these areas became more crowded because of use restrictions in Amistad. Although no studies were available that examined the impact of congestion on the value of a PWC trip, other recreation demand studies find that congestion lowers the value of a recreation experience.

For PWC users who currently use Amistad or who want to use the park in the future, prohibiting or restricting PWC use in the park could result in adverse effects. In the case of Amistad, no comparable substitute areas are available in the vicinity of the park. Given the inferiority of recreational infra-

structure such as launch ramps on the Mexican side of the lake, many boaters would likely not consider that to be a good substitute.

Under alternative A no change in PWC use would be anticipated. PWC users would not be affected.

Because Amistad would still be open to PWC use under alternative B with only minor restrictions on use, this alternative would result in minor losses in consumer surplus.

Under the no-action alternative banning PWC use in Amistad would cause visitors who use personal watercraft exclusively to be adversely affected. In addition, some people using houseboats or power-boats as their primary form of water recreation also ride personal watercraft during their trips; these visitors might decide to cancel trips to the park. Others might still visit, but the value of their trip would be diminished by their inability to use personal watercraft. Since the nearest substitute (besides the Mexican side of the lake) is approximately 130 miles away, adverse effects to vacationers would be mitigated more easily than losses to local PWC users.

COSTS TO LOCAL AREA BUSINESSES

Marinas, PWC sales and rental shops, providers of guest services such as lodging, and convenience / bait stores were identified in the area and were interviewed about the expected impacts of PWC management alternatives. These establishments generally expressed some concern that any restriction on PWC use could reduce sales as a result of negative publicity. Some shops indicated that sales have already fallen due to concerns about future restrictions on PWC use in Amistad. All firms interviewed predicted declines in PWC-related revenue as a result of the no-action alternative, with losses of PWC-related revenue at, or very close to, 100%.

If PWC use decreased as a result of the regulation, then the suppliers of PWC rental, sales, service, and storage services would be directly affected. In addition, lodging establishments, restaurants, gas stations, and other businesses that serve PWC operators could experience a reduction in business from the proposed regulation. One firm sells and services personal watercraft, one firm stores personal watercraft, and one additional firm services personal watercraft in the Amistad area.

Purchases made by PWC users contribute to total economic activity in the area surrounding Amistad. It is possible that localized impacts on tourist-related businesses near Amistad would occur if PWC restrictions result in reduced visitation to the recreation area.

Based on the existing data and interviews with local businesses, alternative A would not result in revenue losses to firms, but alternatives B and C would cause reductions in PWC revenue. However, considering the relatively low levels of PWC use, no measurable impacts on the local or regional economy are expected.

NATIONAL RECREATION AREA MANAGEMENT AND OPERATIONS

CONFLICT WITH STATE AND LOCAL PWC ORDINANCES AND POLICIES

Some states and local governments have taken action, or are considering taking action, to limit, ban, or otherwise manage PWC use. While a national park system unit may be exempt from these local actions, consistency with state and local plans must be evaluated in accordance with the National Environmental Policy Act.

Impacts related to conflicts with state and local ordinances have been analyzed qualitatively using professional judgment to define thresholds or impact magnitude.

Both the National Park Service and the state of Texas have jurisdiction over the surface water within the U.S. portion of Amistad Reservoir. NPS park rangers and the Texas Parks and Wildlife game wardens are the only law enforcement officers enforcing Texas state boating regulations. The U.S. Border Patrol also patrols the Amistad reservoir to deter undocumented aliens and drug trafficking. State regulations are consistent with the NPS regulations at Amistad because the recreation area has adopted the state PWC regulations (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Nov. 5, 2002, re: enforcement). No local regulations affect PWC operations within the recreation area.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. PWC users at the reservoir would be required to follow all applicable state regulations, as well as NPS regulations. Under this alternative NPS rangers would enforce all state regulations within the national recreation area, and there would be no conflicts between park regulations and other regulations. Impacts for alternative A would be negligible since no conflicts with state regulations would occur.

Cumulative Impacts. Personal watercraft are prohibited from landing in Seminole Canyon, starting 0.5 mile from the mouth of the Rio Grande. Seminole Canyon is a state historical park administered by Texas Parks and Wildlife Department. No hiking is allowed in the canyon area without a guide. Alternative A would not be in conflict with state policies or regulations.

Boats are allowed to cross into Mexican waters. Mexico has no known PWC regulations. Therefore, implementation of alternative A would not be in conflict with international policies or regulations.

Cumulative impacts would be negligible under this alternative since management of PWC use would not be in conflict with national, state, or local regulations.

Conclusion. PWC and boating regulations within the national recreation area would be the same as state regulations. Continued PWC use under alternative A would not result in conflicts with state regulations. Therefore, impacts (including cumulative impacts) would be negligible.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. PWC use under alternative B would be managed under current state regulations, except use would be prohibited in San Pedro Canyon, the Pecos River, the northern section of Devils River, and the northern section of the Rio Grande. These restrictions are within the National Park Service's right to regulate activities that can adversely affect resources within the national recreation area. Texas game wardens would only enforce Texas boating regulations at Amistad; they would not enforce park-specific restrictions (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Nov. 6, 2002, re: enforcement). The additional restrictions would be more restrictive than state PWC regulations, but they would not conflict with state provisions or jurisdiction. Therefore, impacts related to conflicts with federal, state, or local requirements or policies would be negligible.

Cumulative Impacts. Cumulative impacts would be similar to alternative A, and no conflicts have been identified. Restrictions on PWC use would be similar to existing restrictions defined in the

"Superintendent's Compendium." No conflicts with federal or state regulations or policies are anticipated from implementing additional restrictions under this alternative. The restrictions would apply only within the national recreation area's jurisdictional boundary. Impacts that are related to conflicts with national, federal, or state requirements or policies would be negligible.

Conclusion. PWC use restrictions under alternative B would not result in conflicts with state PWC regulations or policies. PWC and boating regulations within the national recreation area would be similar to the regulations currently in place for areas now closed to visitor use. The restrictions would apply only within the national recreation area's jurisdictional boundary. Impacts related to conflicts with national, federal, or state requirements or policies would be negligible.

Impacts of the No-Action Alternative — No PWC Use

Analysis. The no-action alternative would ban PWC use within the national recreation area. The National Park Service has the right to regulate the types of activities that take place under its jurisdiction, but Texas game wardens would not enforce park-specific restrictions. State PWC regulations do not have provisions that forbid additional controls or bans, thus additional restrictions would not be in conflict with state regulations or policies. The no-action alternative would not be in conflict with national, federal, or state regulations or policies.

Cumulative Impacts. All the areas where PWC use occurs in the general region around Amistad Reservoir are subject to the same state PWC regulations. Some areas may also have their own policies or requirements, or follow local requirements. While not all of the regional regulations are known, PWC use has not been banned in regional reservoirs. A PWC ban within Amistad National Recreation Area would not create conflicts with other areas that support PWC use or increase any known conflicts with such requirements. Cumulative impacts relating to such conflicts would be negligible.

Boats are allowed to cross into Mexican waters. Mexico has no known PWC regulations. Therefore, implementation of the no-action alternative would not be in conflict with international policies or regulations. Cumulative impacts relating to regulation conflicts would be negligible.

Conclusion. Discontinuing PWC use within the national recreation area would not result in conflict with state PWC regulations. There are no national or local PWC regulations. Therefore, impacts related to such conflicts (including cumulative impacts) would be negligible.

IMPACT TO PARK OPERATIONS FROM INCREASED ENFORCEMENT NEEDS

Director's Order #9: Law Enforcement Program (NPS 2000a), in conjunction with *Reference Manual 9: Law Enforcement,* establishes and defines standards and procedures for NPS law enforcement. Along with education and resource management, law enforcement is an important tool in achieving the NPS goals to protect human life and provide for injury-free visits. Commissioned rangers perform resource stewardship, education, and visitor use management activities, including law enforcement. They provide for tranquil, sustainable use and enjoyment of park resources, while simultaneously protecting these resources from all forms of degradation. The objectives of the law enforcement program are to (1) prevent criminal activities through resource education, public safety efforts, and deterrence, (2) detect and investigate criminal activity, and (3) apprehend and successfully prosecute criminal violators.

Texas Parks and Wildlife Department game wardens would continue to enforce state boating regulations; they would not enforce park-specific PWC regulations (G. Garetz, NPS, pers. comm., P. Steinholtz, URS, Nov. 6, 2002, re: enforcement). Impacts to park operations from increased enforcement needs have been analyzed qualitatively using professional judgment to define thresholds or impact magnitude.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. Under alternative A park staff and Texas game wardens would continue to patrol the reservoir and enforce state regulations relating to PWC use. The park increased law enforcement staff in 2002 to six field law enforcement rangers, which would allow better enforcement of regulations, even with projected increases in PWC and boat use. No additional boats would be required to patrol the reservoir. Therefore, there would be no increased enforcement needed or requested under alternative A. Impacts to park operations from increased enforcement needs would be negligible.

Cumulative Impacts. NPS staff provide enforcement for all activities occurring within the national recreation area. Park staff would likely have to take on more enforcement activities to ensure visitor safety and compliance with regulations and policies. Cumulative impacts would be considered minor, given all the enforcement that currently occurs at the park.

Conclusion. Alternative A would have negligible impacts to park operations because expected increased staff would be able to adequately enforce regulations related to PWC and other users, even accounting for a projected increase in PWC use.

Cumulative impacts would be minor.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. Continuing PWC use within the reservoir, with restrictions in San Pedro Canyon, the Pecos River, and the upper sections of the Devils River and the Rio Grande, would require increased education and enforcement actions by park staff. Texas game wardens would continue to enforce state boating regulations.

To improve and enhance enforcement programs under alternative B so as to reduce accidents and user conflicts, park staff would increase boat patrols, monitor areas by land, and increase the number of rangers (which occurred in 2002). Better materials would be available to educate visitors on PWC regulations and safe operating procedures. These materials would be posted on park bulletin boards, distributed to PWC users at marinas, and posted on the park Web site (perhaps as a PWC-specific link).

Extra staff time would be needed initially to educate visitors about the closed areas. As the public became more aware of the new restrictions, enforcement and educational time would be reduced to current levels, and routine boat patrols would be sufficient to enforce regulations. No additional boats would be required for patrols. Adverse impacts to park operations would be minor in the short term and negligible over the long term as the public began to understand and comply with the new rules.

Cumulative Impacts. Staffing increases in 2002 would allow more boat and land patrols, which would be adequate to enforce the additional use restrictions under this alternative. The staffing

requirements to implement the PWC restrictions would be adequate for handling cumulative impacts related to park operations. Cumulative impacts would be minor, as more visitors became aware of the restrictions included in this alternative.

Conclusion. Alternative B would have short-term, minor adverse impacts on park operations due to the additional duties that would be required by NPS staff to implement and enforce the new PWC regulations and to education visitors.

Cumulative impacts would be minor, as more visitors became aware of the restrictions included in this alternative.

Impacts of the No-Action Alternative — No PWC Use

Analysis. Prohibiting PWC operation within Amistad National Recreation Area would eliminate potential conflicts between PWC recreationists and other user groups, but initially park staff would need to increase visitor educational and enforcement programs. Texas game wardens would continue to enforce state boating regulations, not park-specific PWC closures. Therefore, additional park staff could be required to enforce park-specific regulations. Signs would be posted at the boat launches to indicate PWC use restrictions. Enforcement actions to ensure that PWC use restrictions were not violated could be completed using the existing boat patrols, with the anticipation that PWC users would sometimes operate illegally within the national recreation area. This would result in negligible, short-term, adverse impacts.

Over the long term impacts would be beneficial to park operations and enforcement because the amount of work required for NPS staff to enforce PWC regulations was eliminated. Park staff would not have to monitor areas of PWC concentration as much as they currently do. The PWC ban would give park staff more time to focus on other boating-oriented activities or international uses of the reservoir.

Cumulative Impacts. Cumulative impacts would be similar to alternative A. Banning PWC use would eventually provide park staff who patrol the reservoir with more time to do other enforcement work, creating a beneficial impact.

Conclusion. The no-action alternative would initially result in short-term, minor impacts from enforcement of the PWC ban. Over the long term beneficial impacts to park operations would occur because staff would have additional time to focus on other activities.

Cumulative impacts would continue, but PWC contribution to these impacts would be eliminated.

UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts are impacts that cannot be avoided and cannot be mitigated, and therefore would remain throughout the duration of the action. The following list describes potential adverse impacts related to the alternatives being considered:

- PWC use would continue to cause pollutant emissions into national recreation area water and air under alternatives A and B. These impacts would decrease in the long term due to the required improvements in engine emission technology.

- Under the no-action alternative, the small percentage of PWC users who could no longer ride within the national recreation area would be adversely affected.

LOSS IN LONG-TERM AVAILABILITY OR PRODUCTIVITY TO ACHIEVE SHORT-TERM GAIN

As noted above, some resources would be degraded to some extent through implementation of either alternative A or B.

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irretrievable commitments of resources are those that can be reversed, that is, the commitment of a renewable resource or the short-term commitment of any resource. These include the commitment of water quality and air quality by allowing all mobile sources desiring to do so, including personal watercraft, to continue using the national recreation area under alternatives A and B. The use of fossil fuels to power personal watercraft would be an irretrievable commitment of this resource; however, this use is minor.

CONSULTATION AND COORDINATION

Staff at Amistad National Recreation Area have issued newspaper and magazine articles describing the current situation. The articles resulted in a number of letters and phone calls to Amistad National Recreation Area headquarters during the spring and summer of 2001. The telephone calls and letters have been primarily from park visitors who already own or were intending to buy a personal watercraft. They had heard rumors that all personal watercraft were already banned at Amistad National Recreation Area, and they were inquiring as to whether this was true.

The park has issued three press releases regarding PWC use at Amistad. A press release issued April 11, 2002 informed the public that PWC use was currently permitted at Amistad, to clarify confusion about closure to PWC use. According to the park superintendent, the "time line under which we are operating preclude formal public meetings," but that they "have had extensive consultation with the local stakeholders." A press release issued June 18, 2002 announced that Amistad would be closed to PWC use as of September 15, 2002. A press release dated September 9, 2002, informed the public that PWC use had been extended to November 6, 2002.

In accordance with the Endangered Species Act, a letter was sent on September 25, 2002, to the U.S. Fish and Wildlife Service about the presence of threatened, endangered, and candidate species, as well as species of concern within the area of PWC use in Amistad National Recreation Area. A letter was also sent to the Texas Parks and Wildlife Department to determine if state listed rare species and unique natural features are present in the area of PWC use. The park had received no replies by publication date.

The national recreation area has not officially corresponded with any of the local American Indian tribes.

A copy of this document will be provided to the Texas State Historic Preservation Office for review and comment, and consultation with that office will be completed upon issuance of this environmental assessment to the public.

The following governmental agencies, groups, and organizations will be sent review copies of this *Environmental Assessment.*

U.S. Congressional Delegation
Senator John Cornyn
Senator Kay Bailey Hutchison
Congressman Henry Bonilla

Texas State Legislature
Senator Frank Madla
Representative Pete Gallego

U.S. Agencies
Department of the Air Force, Laughlin Air Force Base
Department of Justice
- Federal Bureau of Investigation
- Immigration and Naturalization Service
  - Border Patrol
    - Del Rio Station
    - Comstock Station
- United States Marshals Service

Department of the Interior
- National Park Service
  - Big Bend National Park
  - Big Thicket National Preserve
  - Chamizal National Memorial
  - Fort Davis National Historic Site
  - Guadalupe Mountains National Park
  - Lake Meredith National Recreation Area
  - Lyndon B. Johnson National Historical Park

- Padre Island National Seashore
- Palo Alto Battlefield National Historic Site
- San Antonio Missions National Historic Park

United States Fish and Wildlife Service
Department of the Treasury
United States Customs Service
International Boundary and Water Commission, Amistad Dam Manager

Mexican Agencies
Cónsul de México (Del Rio TX)
Ciudad Acuña

Texas State Agencies
Department of Transportation
Fish & Game Department
Highway Patrol
Historic Preservation Office
Parks and Wildlife Department
- Devils River State Natural Area
- Judge Roy Bean Visitor Center
- Seminole Canyon State Historic Park

Workforce Commission

Local Agencies
Amistad Land Use and Zoning Commission
City of Del Rio, Texas
- Manager
- Mayor
- Police Department

Kinney County
- Sherriff

Val Verde County
- County Commission
- Health Inspector
- Historical Commission
- Justice of the Peace
- Road and Bridge Superintendent
- Rural Volunteer Fire Department
- Sheriff

Businesses and Organizations
Alamo Bass Club
American Bassin' Couples Association
American Watercraft Association
Amigos Bass Club
Amistad Acres Property Owners Association
Amistad Bass Club
Amistad Bassmasters
Andrews Bass Club
Angler's Choice Team, South Texas Division
Angler's Choice, West Texas Region
Atascosa Bass Club
B.A.S.S.
B.A.S.T. (Bass Anglers of South Texas)
Besta Bassin'
Big Bend Natural History Association
Big Friendly Bass Club
Bluewater Network
Camara de Comercio de Ciudad Acuña
Canyon Bass Club of San Marcos
CAST
CAST Western Div.
Castle Gap Bass Club
Comite de Turismo de Ciudad Acuña
Cooperativa Pescadores, Ciudad Acuña
Del Rio Bass Masters
Del Rio Chamber of Commerce
Del Rio Chamber of Commerce, Lake Committee
Del Rio Council for the Arts
Helotes Bass Club
High Sky Bass Club
Hilltop Bass Club
Hobbs Bass Club
Hockley Co. Bass Club
Ingram Bass Club
Kermit Bass Club
Lake Amistad Resort and Marina, Forever Resorts
Leon Valley Bass Club
Lone Star Lunkers
National Parks and Conservation Association
Nature Conservancy, Dolan Falls Ranch Preserve
Permian Bass Club
Personal Watercraft Industry Association
Rebel Bass Club
Rock Art Foundation
Rough Canyon Marina, Del Rio TX
San Antonio Angler's
San Antonio Bass Club
San Antonio Metropolitan League of Bass Clubs
Sand Hills Bass Club
Sand Hills Bass Club #2
Sand Hills Bass Club #3
SEMARNAT, Ciudad Acuña
Sierra Club
Silver Bullet Bass Busters

Southwinds Marina, Del Rio TX
Sun Country Bass Association
Sun Country Bass Club
SWRI Bass Busters
Texas Association of Bass Clubs
Texas Black Bass Unlimited
Texas Watercraft Association
The Archaeological Conservancy
The Trust for Public Land
Two Guys Marine, Del Rio TX
Universal City Bass Club
Uvalde Bass Club
West Texas Anglers
West TX Anglers Choice
Whitehead Memorial Museum
Wildlife Society

APPENDIX A: EXCERPTS FROM THE SUPERINTENDENT'S COMPENDIUM

UNITED STATES DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

AMISTAD NATIONAL RECREATION AREA

CODE OF FEDERAL REGULATIONS (CFR), TITLE 36, CHAPTER 1

COMPENDIUM, 36 CFR 1.7(b)

§ 1.5 Closures and Public Use Limits

(a) Consistent with applicable legislation and Federal administrative policies, and based upon a determination that such action is necessary for the maintenance of public health and safety, protection of environmental or scenic values, protection of natural or cultural resources, aid to scientific research, implementation of management responsibilities, equitable allocation and use of facilities, or the avoidance of conflict among visitor use activities, the superintendent may:

(1) Establish, for all or a portion of a park area, a reasonable schedule of visiting hours, impose public use limits, or close all or a portion of a park area to all public use or to a specific use or activity.

The following areas are closed to all public use, except where administratively permitted:

1. Hidden Cave Cove (where marked by buoys), located on the Rio Grande.

2. Painted Canyon (where marked by buoys), located on the Rio Grande.

3. Seminole Canyon, starting 0.5 miles from the mouth of the Rio Grande.

Sensitive concentrated cultural resources in these locations require area closures. Seminole Canyon closure prevents access to restricted state park areas.

4. Government coves at Diablo East and Rough Canyon to include the water and shoreline to the top of the ridge/property line.

5. Stairway leading to the government boat dock at Pecos to include government boat dock.

Closures will maintain integrity and security of government emergency response vessels.

6. All terrestrial cave and karst features.

All terrestrial cave and karst features within the boundary of the park are closed to public use to protect the resource until such time as a Cave and Karst Management Plan is developed and implemented. For the purpose of this restriction, cave and karst features include true caves, sinkholes, pits, and fissures, but do not include overhangs and rockshelters.

7. Interior Least Tern nesting colony sites.

Interior Least Terns, a Federally listed endangered species, nest on islands and peninsulas on the lake from May 1 through August 31. To avoid disturbing their nesting activity, these areas will be closed to all public use during their nesting season.

8. The Lower Rio Grande area below Amistad Dam.

The General Management Plan closed this area to the public because of safety and security concerns.

9. The water area extending 300 feet out from the concrete portion of Amistad Dam.

International Boundary and Water Commission has closed this area for safety concerns.

* * *

(2) Designate areas for a specific use or activity, or impose conditions or restrictions on a use or activity

The following activities are restricted:

The following areas are closed to SCUBA diving: designated boat mooring, docking, harbor areas and the submerged historic Devils River Dam and Lake Walk Dam on the Devils River.

This restriction is intended to help insure diver safety from boat traffic and hazardous structures.

The courtesy dock at the Diablo East boat ramp is closed to concessionaire houseboats.

Concessionaire houseboats are restricted to use of the dock provided specifically for them to reduce congestion at the public dock.

The concessionaire houseboat dock at Diablo East is closed to all non-concessionaire vessels.

The houseboat dock at Diablo East is provided by the concessionaire for their exclusive use.

All designated fishing docks are closed to vessels.

These docks are provided for the convenience of the non-boating fishing public.

Rough Canyon mooring cove, located adjacent to the Rough Canyon Marina, is closed to the general public.

This cove is used by the Rough Canyon Marina Concessionaire as a protected cove in which watercraft are moored to buoys. This area is closed for security purposes to anyone not affiliated with registered boat owners renting a mooring buoy.

Tying or mooring a vessel at public docks or pumpouts for longer than 20 minutes is prohibited.

Public docks and sewage pump out stations are provided for the temporary convenience of the public. Time limits are necessary to allow for as many visitors as possible to have access to these facilities.

Tying or mooring a vessel at Panther or Parida Cave docks longer than 60 minutes is prohibited.

Time limits are necessary to allow for as many visitors as possible to have access to these facilities.

The parking of vehicles and boat trailers on the siltation bed at the Pecos launch ramp is prohibited.

The siltation bed in the Pecos River can become hazardous or even flood after a rain. Safety concerns require this restriction to reduce the potential hazard to private vehicles that could be parked for extended periods in the flood plain.

§ 1.6 Permits

(a) When authorized by regulations set forth in this chapter, the superintendent may issue a permit to authorize an otherwise prohibited or restricted activity or impose a public use limit. The activity authorized by a permit shall be consistent with applicable legislation, federal regulations and administrative policies, and based upon a determination that public health and safety, environmental or scenic values, natural or cultural resource, scientific research, implementation of management responsibilities, proper allocation and use of facilities, or the avoidance of conflict among visitor use activities will not be adversely impacted.

(f) A compilation of those activities requiring a permit shall be maintained by the superintendent and available to the public upon request.

The following activities require permits in accordance with the CFR Sections listed:

2.2 hunting

2.5 specimen collection

2.10 camping in designated campgrounds

2.23 recreation fees

2.38 explosives

2.50 special events, including fishing tournaments [(1)]

2.51 public assemblies, meetings

2.52 sale or distribution of printed matter

2.60 livestock use and agriculture

3.3 use of a vessel

4.12 ramp parking permit

5.1 advertisements

5.3 business operations

5.5 commercial photography

5.7 construction of buildings or other facilities

5.10 operating an eating, drinking, or lodging establishment

(1) Special Use Permits: In accordance with RM-53, a special use permit will be required when any fishing tournament exceeds ten (10) boats. The application for special use permits must be received by the park at least 72 hours before and no earlier than 12 months in advance of the tournament start date. A permit processing fee of $25.00 must be sent with the application. Applications will be processed on a first-come, first-served basis, and a permit or other response will be given by park within one week after receipt.

Administrative Costs: The above mentioned non-refundable application processing fee of $25.00 shall accompany the application. (If a tournament director/organizer submits one application for more than one tournament in the calendar year, only one permit will be issued for all the tournaments and only one $25.00 fee will be charged).

Lake Use Fee: All recreational boats on Lake Amistad, including those in fishing tournaments, must display a valid permit costing $4.00/day or $40.00/year. This fee will be collected at tournament registration or before launching.

Management Costs: Under Title 16 and Title 31 of the U.S. Code, the U.S. Congress expects the NPS to be self-sustaining and to charge for a service provided in a fair and cost-effective way. After extensive research and experience, the park has established a standard fee for service provided for a fishing tournament. The fee can include projected costs of preparing for, monitoring, supporting, and cleaning up after the tournament. These costs can be mitigated based on prior arrangements and agreements made at the time of application or up to 72 hours before the tournament start date. The fees are to arrive at the park no later than tournament registration time. The tournament fees are listed below:

*** * ***

§ 2.1 Preservation of natural, cultural and archeological resources.

(a) Except as otherwise provided in this chapter, the following is prohibited:

(4) Using or possessing wood gathered from within the park area: Provided, however, That the superintendent may designate areas where dead wood on the ground may be collected for use as fuel for campfires within the park area.

The gathering of dead and downed wood within the park for the purpose of campfires within the park is permitted.

The limited collection of firewood is a traditional use in this region and causes no significant detrimental effects to the resources.

(5) Walking on, climbing, entering, ascending, descending, or traversing an archeological or cultural resource, monument, or statue, except in designated areas and under conditions established by the superintendent.

The following archeological sites are open to the public with the following restrictions:

1. Panther Cave (41VV83), located in Seminole Canyon. No camping or ground fires permitted.

2. Parida Cave (41VV187), located on the Rio Grande River. No camping or ground fires permitted.

3. Unnamed sites 41VV28, 41VV1694, 41VV1702 and 41VV1703 located on the Devils River. Restrictions determined by posted signs.

4. Policeman's camp, on the Pecos River. Camping is restricted to within 50 feet of the water.

5. Unnamed site 41VV1732 and 41VV1733, located at Spur 406. Restrictions determined by posted signs.

These sites are generally known to the public and are open to the public (with the identified restrictions) as they possess characteristics that allow for such use without unacceptable damage. All other archeological sites are closed to the public for preservation.

(b) The superintendent may restrict hiking or pedestrian use to a designated trail or walkway system.

Panther and Parida Caves – pedestrian traffic is restricted to the designated trail systems.

This restriction is necessary to protect and preserve sensitive cultural resources while still allowing general access to these sites.

* * *

§ 2.22 Property

(a) The following are prohibited:

(2) Leaving property unattended for longer than 24 hours, except in locations where longer time periods have been designated or in accordance with conditions established by the superintendent.

The entire reservoir and shoreline is closed to long-term mooring or beaching of private vessels, except at designated marina anchorage and mooring fields. Vessels and the tires or similar devices used to protect temporarily beached vessels on the shoreline are permitted during the length of stay, provided they are not unattended for more than 24 hours. No more than two tires/devices per vessel are allowed and they must be clearly labeled with owner name and vessel number.

This regulation is intended to reduce visual pollution from the storing of private vessels on the shore of a public reservoir.

Legally registered vehicles and boat trailers may be left unattended at approved parking areas while the associated vessel is in use on the water.

Parking areas are provided specifically for users of the park, but limited space does not allow for parking by persons not using the park.

* * *

§ 3.3 Permits

The superintendent may require a permit for use of a vessel within a park area in accordance with the criteria and procedures of § 1.6 of this chapter.

All motorboats of any size and all sailboats 14 feet in length or longer are required to obtain a valid Amistad NRA recreational lake use fee permit. Unoccupied vessels moored in the park at authorized slips or buoys must display a valid permit within 30 days. An annual fee machine receipt must be exchanged for an annual decal within 14 days. The annual decal must be affixed to the port side of the vessel 6 inches aft of the registration. A valid Lake Meredith NRA recreational lake use permit will be honored at Amistad NRA.

The authority to require a recreational lake use permit is granted in the Recreational Fee Demonstration Program. The superintendents of Amistad and Lake Meredith have determined that a reciprocal agreement to honor lake use permits will benefit recreational users of both areas while not significantly reduce fee revenues.

§ 3.6 Prohibited Operations

The following is prohibited:

(d) Operating a vessel in excess of 5 mph or creating a wake: (1) in areas so designated.

Within harbors, mooring areas, and any "No Wake" buoyed area, operating a vessel in excess of wake speed is prohibited.

Safety concerns dictate that boat operators not operate their vessels at high speed in areas where significant numbers of other vessels operate and land based recreational users swim and fish.

(h) Using trailers to launch or recover vessels, except at designated launching sites.

(i) Launching or recovering by trailer a vessel propelled by machinery at other than designated launch sites.

The boat ramps in the following locations are designated launching sites depending on useable water levels:

1. **Amistad Acres concrete boat ramps ***
2. **Blackbrush Point concrete boat ramps**
3. **Box Canyon concrete boat ramp**
4. **Diablo East concrete boat ramp**
5. **277 North Campground concrete boat ramps**
6. **277 South concrete boat ramp**
7. **Pecos River concrete boat ramp**
8. **Rough Canyon concrete boat ramps**
9. **Air Force (Southwinds Marina) concrete boat ramp**
10. **Spur 406 Campground concrete boat ramps**
11. **Spur 454 concrete boat ramp**
12. **Steam Plant Road concrete boat ramp**

The above sites are public launch ramps specifically developed for vessel launching and retrieving.

* The privately constructed Amistad Acres concrete boat ramps and the old Box Canyon concrete boat ramp will be closed, per the 1999 GMP Amendment, once the new concrete boat ramp at Box Canyon is completed.

The following temporary low water boat ramps may be designated as boat launching sites depending on water levels and safe launching conditions. Approved ramps will be designated with an official NPS sign:

1. **Box Canyon low water boat ramp ***
2. **Spur 454 low water boat ramp at end of roadway**
3. **Spur 406 low water boat ramp at end of roadway**
4. **Spur 406 low water boat ramp at California Creek**
5. **Spur 454 west-side (the saddle) boat ramp**
6. **277 North Campground boat ramp adjacent to old Highway 277 North Bridge**
7. **Pecos low water boat ramp**

* The Box Canyon temporary low water boat ramp will be closed, per the 1999 GMP Amendment, once the new concrete boat ramp at Box Canyon is completed.

Fluctuating water levels may require closure of many of the developed launch ramps, necessitating alternate launch sites for recreational use. The above areas may be suitable for launching and retrieving vessels depending on water levels, while not adversely impacting natural and cultural resources and other visitor activities.

§ 3.20 Water-skiing

(a) The towing of persons by vessels is prohibited, except in designated waters.

Lake Amistad is open to the towing of persons by vessels except in the following areas and the areas described in subsection (4) of the CFR:

1. **That portion of the upper Devils River above the Rough Canyon harbor where marked by "shallow water" and "rock" buoys.**
2. **Those areas marked by a regulatory marker.**
3. **The entire Pecos River arm of the reservoir.**
4. **The arm of the Rio Grande upriver from Seminole Canyon.**
5. **Within "no wake" areas**
6. **In addition to the above restrictions, parasailing is also prohibited within 500 feet of any bridge or above buoy "H" on the Devils River**

These areas present safety hazards to persons being towed by vessels.

§ 3.21 Swimming and Bathing

(a) The following are prohibited:

(1) Swimming or bathing in locations designated as closed.

Swimming and bathing is permitted except in mooring areas, harbors, within 200 feet of fishing docks, and any other area posted as closed to swimming or visitor use.

Safety concerns dictate a separation zone between swimmers and bathers in areas where vessel concentrations and fishing hooks and lines might cause injuries.

(2) Swimming or bathing in violation of designated restrictions.

The use of any soap, detergent or shampoo is prohibited in designated swim areas.

The use of soaps, detergents, or shampoos in concentrated swim areas will cause pollution of reservoir waters in violation of *§ 2.14(a)(6).*

(b) The superintendent may prohibit the use of flotation devices, glass containers, kites, or incompatible sporting activities within locations designated as swimming beaches.

Glass containers are prohibited at the following designated swimming beaches:

- Governors Landing swimming beach
- Viewpoint Road cliffs swimming beach
- Viewpoint Road scuba cove swimming beach
- Rough Canyon swimming beach

The safety of swimmers walking barefoot in these designated areas necessitate prohibiting glass containers. This restriction will not adversely impact recreational users since most items in glass containers can be found in other types of non-breakable containers.

§ 3.23 SCUBA and snorkeling

The following is prohibited:

(a) SCUBA diving and snorkeling within locations designated as swimming, docking, or mooring areas, except in accordance with conditions which may be established by the superintendent.

SCUBA diving and snorkeling are permitted at the Governors Landing swim beach. However, spear guns are prohibited in any swimming beach area, including the SCUBA cove.

This allows easier access to some areas for SCUBA diving but also provides for the safety of other swimmers in the area.

§ 3.24 Where may I use personal watercraft?

(b) Designation of areas for personal watercraft use requires the promulgation of special regulations, except for the following park areas: Amistad..., where personal watercraft use may be designated using the procedures of § § 1.5 and 1.7 of this chapter [until September 15, 2002].

The use of personal watercraft (PWC) within Amistad National Recreation Area is authorized, except in areas restricting vessels, which include personal watercraft. Operators of personal watercraft are subject to all applicable Federal and State laws. Regulations applying to vessels include personal watercraft.

Bluewater Network filed a civil suit against the National Park Service challenging a March 2000 Final Rule of the National Park Service which permitted personal watercraft (PWC) use to continue in 21 National Park Service units, including Amistad.

On April 12, 2001, the U.S. District Court for the District of Columbia approved a Settlement Agreement between the Bluewater Network and the National Park Service. As part of the Settlement Agreement, Amistad may continue to allow PWC use until September 15, 2002. After September 15, 2002, Amistad may only authorize PWC use by promulgating Special Regulations. Those Special Regulations must be based on appropriate environmental analysis under the National Environmental Policy Act. The analysis must evaluate the impacts of PWC use at Amistad, including impacts on water quality, air quality, soundscapes, wildlife and wildlife habitat, shoreline vegetation, and visitor conflicts and safety.

Based on the enabling legislation for Amistad, park management is pursuing the Environmental Analysis and Special Regulations process covering PWC use at Amistad.

* * *

APPENDIX B: APPROACH TO EVALUATING SURFACE WATER QUALITY IMPACTS

Objective

Using simplifying assumptions, estimate the minimum (threshold) volume of water in a reservoir or lake below which concentrations of gasoline constituents from personal watercraft or outboards would be potentially toxic to aquatic organisms or humans. Using the estimated threshold volumes, and applying knowledge about the characteristics of the receiving waterbody and the chemical in question, estimate if any areas within the waterbody of interest may present unacceptable risks to human health or the environment.

Overall Approach

Following are the basic steps in evaluating the degree of impact a waterbody (or portion of a waterbody) would experience based on an exceedance of water quality standards / toxicity benchmarks for PWC- and outboard-related contaminants.

1. Determine concentrations of polycyclic aromatic hydrocarbons (PAHs), benzene, and methyl tertiary-butyl ether (MTBE) in gasoline (convert from weight percent to mg/L, as needed) and PAHs in exhaust. The half-life of benzene in water is 5 hours at 25°C (Verschuren 1983; US EPA 2001).
2. Estimate loading of PAHs, benzene, and MTBE for various appropriate PWC-hour levels of use for one day (mg/day)
3. Find/estimate ecological and human health toxicity benchmarks (risk-based concentrations [RBCs]) (micrograms [µg]/L) for PAHs, benzene, and MTBE.
4. Divide the estimated loading for each constituent (µg) by a toxicity benchmark (µg /L) to determine the waterbody threshold volume (L) below which toxic effects may occur (convert liters to acre-feet).

Estimated hydrocarbon (HC) emissions from personal watercraft and outboards will be substantially reduced in the near future, based on regulations issued by the U.S. Environmental Protection Agency and the California Air Resources Board (CARB) (see the estimated reductions in Table 18 in the "Methodologies and Assumptions" section under "Water Quality"). Other states may also have emission reduction programs that must be applied.

Assumptions and Constants

Several assumptions must be made in order to estimate waterbody threshold volumes for each HC evaluated. Each park should have park-specific information that can be used to modify these assumptions or to qualitatively assess impacts in light of park-specific conditions of mixing, stratification, etc. and the characteristics of the chemicals themselves. The assumptions are as follows:

- BTEX (benzene, toluene, ethyl benzene, and xylene) are volatile and do not stay in the water column for long periods of time. Because benzene is a recognized human carcinogen, it is retained for the example calculations below and should be considered in each environmental assessment or environmental impact statement (Verschuren 1983; US EPA 2001).
- MTBE volatilizes slightly and is soluble in water. MTBE may accumulate in water from day to day, but this is not factored into the calculation and should be considered qualitatively in the assessment.
- PAHs volatilize slightly (depending on structure and molecule size) and may adhere to sediment and settle out of the water column or float to the surface and be photo-oxidized. They may accumulate in water from day to day, but this is not factored into the calculation and should be considered qualitatively in the assessment.

- The toxicity of several PAHs increases (by several orders of magnitude) when the PAHs are exposed to sunlight. This was not incorporated because site-specific water transparency is not known, and should be discussed qualitatively.
- The threshold volume of water will mix vertically and aerially with contiguous waters to some extent, but the amount of this mixing will vary from park to park and location to location in the lake, reservoir, river, etc. Therefore, although the threshold volume calculation assumes no mixing with waters outside the "boundary" of the threshold volume of water, this should be discussed in the assessment after the threshold volume is calculated. The presence or absence of a thermocline should also be addressed.
- Volume of the waterbody, or portion thereof, is estimated by the area multiplied times the average depth.

In addition to these assumptions, several constants required to make the calculations were compiled from literature and agency announcements. Gasoline concentrations are provided for benzene, MTBE and those PAHs for which concentrations were available in the literature. Constants used are:

- Gasoline emission rate for two-stroke personal watercraft: 3 gal/hour at full throttle (CARB 1998)
- Gasoline emission rate for two-stroke outboards: estimated at approximately the same as for personal watercraft for same or higher horsepower outboards (80–150 hp); approximately twice that of personal watercraft for small (e.g., 15 hp) outboards. (Note: Assume total hours of use for the various size boats/motors, and that smaller 15 hp motors that exhaust relatively more unburned fuel would probably be in use for a much smaller amount of time than the recreational speedboats and PWC). This estimate is based on data from Allen et al. 1998 (figure 5). It is noted that other studies may indicate different relative emission rates (e.g., about the same emissions regardless of horsepower, or larger horsepower engines having higher emission rates than smaller engines [CARB 2001]). The approach selected represents only one reasonable estimate.
- 1 gallon = 3.78 liters
- Specific gravity of gasoline: 739 g/L
- 1 acre-foot = 1.234×10^6 L
- Concentration of benzo(a)pyrene (B[a]P) in gasoline: up to 2.8 mg/kg (or 2.07 mg/L) (Gustafson et al. 1997)
- Concentration of naphthalene in gasoline: 0.5% or 0.5 g/100 g (or 3,695 mg/L) (Gustafson et al. 1997)
- Concentration of 1-methyl naphthalene in gasoline: 0.78% or 0.78 g/100 g (or approx. 5,760 mg/L) (estimated from Gustafson et al. 1997)
- Concentration of benzene in gasoline: 2.5% or 2.5 g/100 g (or 1.85×10^4 mg/L) (Hamilton 1996)
- Concentration of MTBE in gasoline: up to 15% or 15 g/100 g (or approx. 1.10×10^5 mg/L) (Hamilton 1996). (Note: MTBE concentrations in gasoline vary from state to state. Many states do not add MTBE.)
- Estimated emission of B(a)P in exhaust: 1080 μg/hr (from White and Carroll, 1998, using weighted average B(a)P emissions from 2-cylinder, carbureted two-stroke liquid cooled snow mobile engine using gasoline and oil injected Arctic Extreme injection oil, 24-38:1 fuel:oil ratio. Weighted average based on percentage of time engine was in five modes of operation, from full throttle to idle).
- Estimated amount of B(a)P exhaust emissions retained in water phase = approximately 40% (based on value for B(a)P from Hare and Springier, cited in North American Lake Management Society 2001).

Toxicity Benchmarks

A key part of the estimations is the water quality criterion, standard, or toxicological benchmark for each contaminant evaluated. There are no EPA water quality criteria for the protection of aquatic life for the PWC-related contaminants (US EPA 1999a). There are, however, a limited number of EPA criteria for the protection

of human health (via ingestion of water and aquatic organisms or ingestion of aquatic organisms only). Chronic ecotoxicological and human health benchmarks for contaminants were acquired from various sources.

Ecotoxicological benchmarks for benzo(a)pyrene, naphthalene, and benzene are from *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision* (Suter and Tsao 1996). The ecotoxicological benchmarks for benzo(a)pyrene (0.014 µg/L) and benzene (130 µg/L) are Tier II Secondary Chronic Values in Table 1 of Suter and Tsao (1996), which were calculated using methods in the Great Lakes Water Quality Initiative (US EPA 1993). The ecotoxicological benchmark for naphthalene (62 µg/L) is the EPA Region 4 chronic screening value (Table 3 of Suter and Tsao 1996). This screening value was chosen for use as a conservative mid-range value considering the wide range of chronic values for naphthalene (12-620 µg/L) shown in Suter and Tsao (1996). The ecotoxicological benchmarks for 1-methyl naphthalene (19 and 34 µg/L) are based on LC_{50} values of 1900 and 3400 µg/L for the marine invertebrate, dungeness crab (*Cancer magister*), and the fresh water/estuarine fish, sheepshead minnow (*Cyprinodon variegatus*), respectively (USFWS 1987). The MTBE benchmarks of 18,000 and 51,000 µg/L are for marine and fresh water, respectively, and are based on the preliminary chronic water quality criteria presented in Mancini et al. (2002).

Following are the default toxicity benchmarks for the PAHs, benzene, and MTBE having gasoline concentration information:

Chemical	Ecotoxicological Benchmark (µg/L)	Source	Human Health Benchmark** (µg/L)	Source
Benzo(a)pyrene	0.014	Suter and Tsao 1996	0.0044** 0.049***	US EPA 1999a
Naphthalene	62	Suter and Tsao 1996	--	--
1-methyl naphthalene	19* 34*	USFWS 1987	--	--
Benzene	130	Suter and Tsao 1996	1.2** 71***	US EPA 1999a
MTBE****	18,000 51,000	Mancini et al. 2002	13	CA DHS 2002

* Based on LC_{50}s of 1900 and 3400 µg/L for dungeness crab and sheepshead minnow, respectively (19 µg/L used for marine/estuarine calculations; 34 µg/L used for freshwater calculations).

** Based on the consumption of water and aquatic organisms.

*** Based on the consumption of aquatic organisms only.

**** Ecotoxicological benchmarks, which are considered preliminary chronic water quality criteria, are 18,000 µg/L for marine and 51,000 µg/L for freshwater. There is no EPA human health benchmark, but California DHS (2002) has established a primary maximum contaminant level (MCL) of 13 µg/L..

Example Calculations

Calculations of an example set of waterbody volume thresholds are provided below for the chemicals listed above together with their concentrations in gasoline and available toxicity benchmarks.

Loading to Water

Loadings of the five contaminants listed above are calculated for one day assuming 10 personal watercraft operate for four hours (40 PWC-hours), each discharging 11.34 L gasoline per hour and having concentrations in fuel or exhaust as listed.

Benzo(a)pyrene (from the fuel): 40 PWC-hrs × 11.34 L gas/hr × 2.07 mg/L = 939 mg

Benzo(a)pyrene (from the gas exhaust): 40 PWC-hrs × 1080 µg/hr × 1/1000 mg/µg × 0.40 = 17 mg

Total B(a)P = 956 mg

Naphthalene: 40 PWC-hrs × 11.34 L gas/hr × 3695 mg/L = 1.68×10^6 mg

1-methyl naphthalene: 40 PWC-hrs × 11.34 L gas/hr × 5764 mg/L = 2.62×10^6 mg

Benzene: 40 PWC-hrs × 11.34 L gas/hr × 1.85×10^4 mg/L = 8.39×10^6 mg

MTBE: 40 PWC-hrs × 11.34 L gas/hr × 1.10×10^5 mg/L = 4.99×10^7 mg

Loadings of contaminants from two-stroke outboards should be estimated based on the estimated loading based on the horsepower of the outboards involved (see "Assumptions and Constants" above) and the estimated hours of use, based on the types of boats and the pattern of use observed.

Threshold Volumes

Threshold volumes of water (volume at which a PWC- or outboard-related contaminant would equal the benchmarks listed above) are calculated by dividing the estimated daily loadings (mg of contaminant) for the number of operational hours (e.g., 40 PWC-hours) by the listed toxicity benchmark concentrations (µg/L), correcting for units (1 mg = 10^3 µg), and converting from liters to acre-feet (1 ac-ft = 1.234 x 10^6 L):

Protection of Freshwater Aquatic Organisms

Benzo(a)pyrene: 956 mg B(a)P × 10^3 µg/mg / 0.014 µg/L = 6.8×10^7 L or 55 ac-ft

Naphthalene: 1.68×10^6 mg naphthalene × 10^3 µg/mg / 62 µg/L = 2.71×10^7 L or 22 ac-ft

1-methyl naphthalene: 2.62×10^6 mg 1-methyl naphthalene × 10^3 µg/mg / 34 µg/L = 7.69×10^7 L or 62 ac-ft

Benzene: 8.39×10^6 mg benzene × 10^3 µg/mg / 130 µg/L = 6.45×10^7 L or 52 ac-ft

MTBE: 4.99×10^7 mg MTBE × 10^3 µg/mg / 51,000 µg/L = 9.78×10^5 L or 0.79 ac-ft

Based on these estimates and assumptions, 1-methyl naphthalene appears to be the contaminant (of those analyzed) that would be the first to accumulate to concentrations potentially toxic to freshwater aquatic organisms (i.e., it requires more water [62 ac-ft] to dilute the contaminant loading to a concentration below the toxicity benchmark). However, the threshold volumes are very similar for 1-methyl naphthalene, benzo(a)pyrene, and benzene.

Protection of Human Health

Benzo(a)pyrene: 956 mg B(a)P × 10^3 µg/mg / 0.0044 µg/L = 2.17×10^8 L or 176 ac-ft

Benzene: 8.39×10^6 mg benzene × 10^3 µg/mg / 1.2 µg/L = 6.99×10^9 L or 5,670 ac-ft

MTBE: 4.99×10^7 mg MTBE × 10^3 µg/mg / 13 µg/L = 3.83×10^9 L or 3,110 ac-ft (if the CA MCL of 13 µg/L for fresh water is used)

The California public health goal for MTBE is a drinking water–based MCL and is not as broadly applicable as the other criteria used in this analysis. However, it may be of interest, since MTBE is very soluble, and MTBE concentration could be an issue if the receiving body of water is used for drinking water purposes and MTBE is not treated. Using the numbers provided above, benzene would be the first PWC-related contaminant in these example calculations that would reach unacceptable levels in surface water; however, volatilization of benzene from water to air was not included in the calculation. MTBE would be the next contaminant to reach unacceptable concentrations. If human health water quality criteria for ingestion of aquatic organisms only were used for benzo(a)pyrene and benzene (0.049 µg/L and 71 µg/L, respectively), the corresponding threshold volumes would be 15.8 acre-feet and 95.8 acre-feet.

As a result of the estimated reductions in HC emissions (from the unburned fuel) in response to EPA regulations (listed above), additional personal watercraft and/or outboards may be used in the parks without additional impacts to water quality. For example, based on the expected overall reductions from the US EPA (1996a, 1997), up to twice the current number of personal watercraft/outboards may be used in a given area in 2012 without additional impacts to water quality over current levels. Effects on noise levels, physical disturbance, or hydrocarbon emissions that are products of combustion (e.g., B[a]P) may not be similarly ameliorated by the reduced emission regulations.

Application of Approach

The approach described above for evaluating possible exceedance of standards or other benchmarks must be adapted to the unique scenarios at each park, PWC use, and waterbody being evaluated. State water quality standards (including numeric standards and descriptive text) must be reviewed and applied, as appropriate.

Factors that would affect the concentration of the contaminants in water must be discussed in light of the park-specific conditions. These factors include varying formulations of gasoline (especially for MTBE); dilution due to mixing (e.g., influence of the thermocline), wind, currents, and flushing; plus loss of the chemical due to volatilization to the atmosphere (Henry's Law constants can help to predict volatilization to air; see Yaws et al. 1993); adsorption to sediments and organic particles in the water column (e.g., PAHs), oxidation, and biodegradation (breakdown by bacteria). Toxicity of phototoxic PAHs may be of concern in more clear waters, but not in very turbid waters.

The chemical composition of gasoline varies by source of crude oil, refinery, and distillation batch. No two gasolines have the exact same chemical composition. For example, B(a)P concentrations may range from 0.19 to 2.8 mg/kg, and benzene concentrations may range from 0 to 7% (2 to 3% is typical). MTBE concentrations will vary from state to state and season to season, with concentrations ranging from 0 to 15%. The composition of gasoline exhaust is dependent on the chemical composition of the gasoline and engine operating conditions (i.e., temperature, rpms, and oxygen intake). If site-specific information is available on gasoline and exhaust constituents, they should be considered in the site-specific evaluation. If additional information on the toxicity of gasoline constituents (e.g., MTBE) become available, they should be considered in the site-specific evaluation.

Table B-1 summarizes some of the results presented in various documents on the concentrations of benzene, PAHs, and MTBE.

Table B-1: Pollutant Concentrations Reported in Water

Pollutant	Source(s)	Levels Found	
		"Lower Use" (e.g., open water, offshore locations; reduced motorized watercraft use)	"Higher Use" (e.g., nearshore, motorized watercraft activity high)
Benzene	*Lake Tahoe Motorized Watercraft Report* (Allen et al. 1998); several studies cited		
	1. USGS	1. <0.032 µg/l	1. 0.13 – 0.33 µg/l
	2. Miller and Fiore	2. ≤0.3 µg/l	2. just over 1 µg/l
	3. U of CA	3. <0.1 µg/l	3. 0.1 – 0.9 µg/l
PAHs	A. Mastran et al. 1994	A. All below detection limits (<0.1 µg/l for pyrene and naphthalene; <2.5 µg/l for B(a)P, B(a)A, chrysene)	A. Total PAHs – up to 4.12 µg/l in water column; total PAHs – up to 18.86 µg/l in surface sample at marina, with naphthalene at 1 µg/l; B(a)P – ≥2.3 µg/l
	B. Oris et al. 1998	B. Experiment #1 – 2.8 ng/l phototoxic PAHs	B. Experiment #1 – ± 45 ng/l phototoxic PAHs; 5–70 ng/L total PAHs
MTBE	A. *Lake Tahoe Motorized Watercraft Report* (Allen et al. 1998); several studies cited		
	1. USGS	1. 0.11 – 0.51 µg/l	1. 0.3 – 4.2 µg/l
	2. Miller and Fiore	2. ≤3 µg/l	2. 20 µg/l (up to approx. 31 µg/l)
	3. U of CA	3. less than nearshore area	3. up to 3.77 µg/l
	4. U of Nevada – Fallen Leaf Lake	4. --	4. 0.7 – 1.5 µg/l
	5. Donner Lake (Reuter et al. 1998)	5. <0.1 µg/l	5. up to 12 µg/l (Dramatic increase from 2 to 12 µg/l from July 4 to 7)
	B. NPS, VanMouwerik and Hagemann 1999		
	6. Lake Perris	6. 8 µg/l (winter)	6. up to 25 µg/l
	7. Shasta Lake		7. 9–88 µg/l over Labor Day weekend
	8. 3-day Jet Ski event		8. 50–60 µg/l
	9. Lake Tahoe		9. often within range of 20–25 µg/l, with max of 47 µg/l

GLOSSARY

BTEX — benzene, toluene, ethylbenzene, and xylene

national ambient air quality standards (NAAQS) — Concentrations of criteria pollutants in ambient air (outdoor air to which the public may be exposed) below which it is safe for humans or other receptors to be permanently exposed. The Clean Air Act establishes two types of national air quality standards. **Primary standards** set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. **Secondary standards** set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

Nonroad Model — An air quality emissions estimation model developed by the U.S. Environmental Protection Agency to estimate emissions from various spark-ignition type "nonroad" engines. The June 2000 draft of the nonroad model was used to estimate air pollutant emissions from personal watercraft. It is available at <http://www.epa.gov/otaq/ nonrdmdl.htm>.

personal watercraft (PWC) — As defined in 36 CFR §1.4(a) (2000), refers to a vessel, usually less than 16 feet in length, which uses an inboard, internal combustion engine powering a water jet pump as its primary source of propulsion. The vessel is intended to be operated by a person or persons sitting, standing, or kneeling on the vessel, rather than within the confines of the hull. The length is measured from end to end over the deck excluding sheer, meaning a straight line measurement of the overall length from the foremost part of the vessel to the aftermost part of the vessel, measured parallel to the centerline. Bow sprits, bumpkins, rudders, outboard motor brackets, and similar fittings or attachments, are not included in the measurement. Length is stated in feet and inches.

SUM06 — The cumulation of instances when measured hourly average ozone concentrations equal or exceed 0.06 part per million (ppm) in a stated time period, expressed in ppm-hours.

thermocline — The region in a thermally stratified body of water that separates warmer, oxygen-rich surface water from cold, oxygen-poor deep water. In a thermocline, temperature decreases rapidly with depth.

SELECTED BIBLIOGRAPHY

The following abbreviations are used for bibliographic references in the text:

AWA	American Watercraft Association
CARB	California Air Resources Board
FHWA	Federal Highway Administration, U.S. Department of Transportation
IBWC	International Boundary and Water Commission, United States and Mexico
IWL	Izaak Walton League of America
NPS	National Park Service, U.S. Department of the Interior
NTSB	National Transportation Safety Board
ODEQ	Oregon Department of Environmental Quality
PWIA	Personal Watercraft Industry Association
SAE	Society of Automotive Engineers
TCEQ	Texas Commission on Environmental Quality
TNRCC	Texas Natural Resource Conservation Commission
TRPA	Tahoe Regional Planning Agency
TPWD	Texas Parks and Wildlife Department
US EPA	Environmental Protection Agency
USGS	U.S. Geological Survey, U.S. Department of the Interior

Albers, Peter H.
2000 "Sources, Fate, and Effects of PAHs in Shallow Water Environments." In *Impacts of Motorized Boats on Shallow Water Systems,* Science Workshop Abstracts, November 7–8, 2000, Douglass College Center, Rutgers, the State University of New Jersey. Rutgers, NJ.

Allen, B. C., J. E. Reuther, C. R. Goldman, M. F. Fiore, and G. C. Miller
1998 "Lake Tahoe Motorized Watercraft Report — An Integration of Water Quality, Watercraft Use and Ecotoxicology Issues." Preliminary draft report prepared for the Tahoe Regional Planning Agency.

American Academy of Pediatrics
2000 "Policy Watercraft Use by Children and Adolescents." Policy Statement. *Pediatrics* 105 (no. 2): 452–53.

American Canoe Association
2002 *Hostile Waters — The Impacts of Personal Watercraft Use on Waterway Recreation,* by David Jenkins. Available at <http://www.acanet.org>.

American Watercraft Association
2001 "The Advocate Action Kit: Personal Watercraft and the Environment." Burbank, CA.

Amistad Scuba Divers
2002 <http://www.amistadscubadivers.com>.

Anderson, Franz E.
2000 "Effect of Wave-wash from Personal Watercraft on Salt Marshes." In *Impacts of Motorized Boats on Shallow Water Systems,* Science Workshop Abstracts, November 7–8, 2000, Douglass College Center, Rutgers, the State University of New Jersey. Rutgers, NJ.

Arfsten, D. P., D. J. Schaeffer, and D. C. Mulveny
1996 "The Effects of Near Ultraviolet Radiation on the Toxic Effects of Polycyclic Aromatic Hydrocarbons in Animals and Plants: A Review." *Ecotoxicology and Environmental Safety* 33:1–24.

Asplund, Tim
2001 "The Effects of Motorized Watercraft on Aquatic Ecosystems." Draft paper. Wisconsin Department of Natural Resources and University of Wisconsin, Madison.

Bluewater Network
2001 "Jet Skis Position Paper." Available at <1http://www.earthisland.org/bw/jetskipos.html>.

Branche, C. M., J. M. Conn, J. L. Annest
1997 "Personal Watercraft-Related Injuries: A Growing Public Health Concern." *Journal of the American Medical Association* 278(8): 663–65.

British Columbia Ministry of Water, Land, and Air Protection
1993 "Ambient Water Quality Criteria for Polycyclic Aromatic Hydrocarbon (PAHs)." Available at: http://wlapww.gov.bc.ca/wat/wq/bcguidelines/pahs.html.

Bruer and Kjaer
2002 "Environmental Noise." Available at <http://www.nonoise.org/library/envnoise/index.htm>. Site visited in 2002.

Burger, J.
1998 "Effects of Motorboats and Personal Watercraft on Flight Behavior over a Colony of Common Terns." *The Condor* 100: 528–34.

2000 "Managing Personal Watercraft around Tern Colonies." In *Impacts of Motorized Boats on Shallow Water Systems,* Science Workshop Abstracts, November 7–8, 2000, Douglass College Center, Rutgers, the State University of New Jersey. Rutgers, NJ.

Burger, J., and J. Leonard
1999 "Conflict Resolution in Coastal Waters: the Case of Personal Watercraft." *Marine Policy* 24: 61–67.

California Air Resources Board
1997 "Sources and Control of Oxides of Nitrogen Emissions." Stationary Source Control Division and Mobile Source Control Division.

1998 "Proposed Regulations for Gasoline Spark-Ignition Marine Engines, Draft Proposal Summary." Mobile Resources Control Division.

1999 "Fact Sheet – New Regulations for Gasoline Engines." Available at <www.arb.ca.gov/msprog/marine/marine.htm>.

2001 "Outboard Engine and Personal Watercraft Emissions to Air and Water: A Laboratory Study." Prepared by Mobile Source Control Division and Monitoring and Laboratory Division.

California Department of Health Services
2002 "MTBE in California Drinking Water." Prevention Services, Division of Drinking Water and Environmental Management. Available at <www.dhs.ca.gov/ps/ddwem/chemicals/MTBE/mtbeindex.htm> (latest update: August 7, 2002).

California State University Biological Web Server
2002 "Western burrowing owl." Available at < http://arnica.csustan.edu/ESRPP/burowl.htm>.

City of Austin
2002 "Watershed Protection Development Review: Hydrilla." Available at <www.ci.austin.tx.us/watershed/hydrilla.htm>.

Coalition of Parents and Families for Personal Watercraft Safety
2000 "Statistics." Available at <http://www.pwcwatch.org/statistics.htm>.

Continental Shelf Associates
1997 "Effects of Personal Watercraft Operation on Shallow-water Seagrass Communities in the Florida Keys." Prepared for the for Personal Watercraft Industry Association. Jupiter, FL.

Davis, William B. and David J. Schmidly
2002 "The Mammals of Texas — Online Edition." Available at < http://www.nsrl.ttu.edu/tmot1/>. Accessed in 2002.

Dun & Bradstreet
2001 *Industry Norms & Key Business Ratios.* Murray Hill, NJ: Dun & Bradstreet.

Earth Share of California
n.d. "The Hazards of Personal Watercraft." *Making Waves* 15, no. 3. Available at <http://www.earthshareca.org/about/features/skidoos.htm>.

eNature.com
2002 "Zone-tailed hawk." Available at < http://www.enature.com/>.

Federal Highway Administration, U.S. Department of Transportation
2000 *Highway Traffic Noise in the United States, Problem and Response*. Available at <http://www.fhwa.dot/gov/environment/probresp.htm>.

Florida Fish and Wildlife Conservation Commission
2000 "Buffer Zone Distances to Protect Foraging and Loafing Waterbirds from Disturbance by Personal Watercraft in Florida (Study 7520)." Prepared by J. Rodgers Jr. Bureau of Wildlife Diversity Conservation. Gainesville, FL.

Garetz, Greg
2002a "Boating Accidents and Tickets Issued at Amistad." Memo. On file at Amistad National Recreation Area, Del Rio, TX.

2002b "PWC and Boat Trailer Counts Conducted at Amistad Boat Launches from May 2001 to August 2002." On file at Amistad National Recreation Area, Del Rio, TX.

Gustafson, J. B., J. G. Tell, and D. Orem
1997 "Selection of Representative TPH Fractions Based on Fate and Transport Considerations." Final draft. Vol. 3. TPH Criteria Working Group, Fate and Transport Technical Action Group. Amherst Scientific Publishing.

Hamilton, Bruce
1996 "FAQ: Automotive Gasoline." 4 parts. Available at <www.faqs.org/faqs/autos/gasoline-faq>.

Hare, C. T., and K. J. Springier
1973 "Exhaust Emissions from Uncontrolled Vehicles and Related Equipment Using Internal Combustion Engines." Final Report. Part Two: "Outboard Motors." Prepared for the U.S. Environmental Protection Agency by Southwest Research Institute, San Antonio, TX. Available at <http://www.nalms.org/bclss/impactsoutboard.htm>.

Harris Miller Miller & Hanson, Inc.
2002 *Draft Technical Report on Noise: Personal Watercraft and Boating Activities at Glen Canyon National Recreation Area*. Produced under contract to the National Park Service. Harris Miller Miller & Hanson Inc.

Hayes, Reagan
2002 "Can A New Breed of PWC Stem Sales Decline?" *Soundings Trade Only,* February. Soundings Publication LLC. Available at <http://www.pwia.org/articles01.htm>. Site visited June 24, 2002.

International Boundary and Water Commission, United States and Mexico
2002a Monitoring Stations for the Rio Grande Basin. Available at <http://www.ibwc.state.gov/CRP/monstats.htm>.

2002b *Updated Rio Grande National Ownership of Waters Stored at the International Amistad and Flacon Dams*. Available at <www.ibwc.state.gov/wad/storage.htm>.

Izaak Walton League of America
1999 *Caught in the Wake. The Environmental and Human Health Impacts of Personal Watercraft,* by Laurie C. Martin. Available at <http://www.iwla.org>.

Jacques Cousteau National Estuarine Research Reserve and New Jersey Department of Environmental Protection, Coastal Management Program
2000 "Impacts of Motorized Boats on Shallow Water Systems." Science Workshop Abstracts, Nov. 7–8, 2000. Douglass College Center, Rutgers, the State University of New Jersey.

Kado, Norman Y., Robert F. Okamoto, John Karim, and Paul A. Kuzmicky
2000 "Airborne Particle Emissions from 2-Stroke and 4-Stroke Outboard Marine Engines: Polycyclic Aromatic Hydrocarbon and Bioassay Analyses." *Environmental Science & Technology* 34(13): 2714–20.

Kenmotsu, Nancy A., and Mariah F. Wade
2002 "American Indian Tribal Affiliation Study, Phase I: Ethnohistoric Literature Review, Amistad National Recreation Area Del Rio, Texas." Jointly published by the Texas Department of Transportation (Archeological Studies Program, Report No. 34) and the National Park Service, Amistad National Recreation Area.

Komanoff, Charles, and Howard Shaw
2000 *Drowning in Noise: Noise Costs of Jet Skis in America.* A Report for the Noise Pollution Clearinghouse. Available on the Internet at <http://www.noise.org/library/drowing>.

Labadie, Joseph
1999 "Cultural Resources Management at the Amistad National Recreation Area, Del Rio, Texas." *La Tiera, Journal of the Southern Texas Archeological Society* 26 (1): 19-22.

Landrum, P. F., J. P. Geisy, J. T. Oris, and P. M. Allred
1987 "Photoinduced Toxicity of Polycyclic Aromatic Hydrocarbons to Aquatic Organisms." In *Oil in Freshwater: Chemistry, Biology, Countermeasure Technology,* edited by J.H. Vandermeulen and S.E. Hrudey, 304–18. Ontario, Canada: Pergamon Press.

LAW Engineering and Environmental Sciences, Inc., Arcadis JSA, and RTI
2002 "Economic Analysis of Personal Watercraft Regulations in Amistad National Recreation Area." Prepared for the National Park Service. Kennesaw, GA.

Mace, B. E., R. D. Nine, N. N. Clark, T. J. Vanyo, V. T. Remcho, and R. W. Morrison
1998 "Emissions from Marine Engines with Water Contact in the Exhaust Stream." SAE Technical Paper Series. Warrendale, PA.

Mancini, E. R., A. Steen, G. A. Rausina, D. C. L. Wong, W. R. Arnold, F. E. Gostomski, T. Davies, J. R. Hockett, W. A. Stubblefield, K. R. Drottar, T. A. Spring, and P. Errico
2002 "MTBE Ambient Water Quality Criteria Development: A Public/Private Partnership." *Environmental Science and Technology* 36: 125–29.

Mastran, Trina A., Andrea M. Dietrich, Daniel J. Gallagher, and Thomas J. Grizzard
1994 "Distribution of Polyaromatic Hydrocarbons in the Water Column and Sediments of a Drinking Water Reservoir with Respect to Boating Activity." *Water Resources* 28 (11): 2353–66.

Mekenyan, O. G., G. T. Ankely, G. D. Veitt, and D. J. Call
1994 "QSARs for Photoinduced Toxicity: I. Acute Lethality of Polycyclic Aromatic Hydrocarbons into Daphnia Magna." *Chemosphere* 28:56782.

Mestre Greve Associates
1992 *Noise Assessment for Beaver Basin Rim Road. Pictured Rocks National Lakeshore.* Prepared for the National Park Service. Newport Beach, CA.

National Academy of Sciences
1972 *Particulate Polycyclic Organic Matter.* Washington, DC.

National Marine Manufacturers Association
2000 *1999 U.S. Recreational Boat Registration Statistics.* Chicago, IL. Available at <http://www.nmma.org/>.

National Park Service, U. S. Department of the Interior
1987 *Amistad General Management Plan, Development Concept Plan*. Del Rio, TX.

1994 *Amistad National Recreation Area Cultural Resources Study*, by Joe Labadie. On file at Amistad National Recreation Area, Del Rio, TX.

1995a "A Close Look at the Rock Art of Amistad National Recreation Area, Texas." *Park Science* 15 (4).

1995b *Baseline Water Quality Inventory and Analysis Amistad National Recreation Area*. U.S. Department of the Interior, Water Resources Division, Ft. Collins, CO. Technical Report NPS/NRWRD/NRTR-95/72. December.

1995c *How to Apply the National Register Criteria for Evaluation.* Available at <www.cr.nps.gov/nr/publications/bulletins/>.

1995d *Secretary of the Interior's Standards for the Treatment of Historic Properties.* Available at <www2.cr.nps.gov/tps/secstan1.htm>.

1996 *The Secretary of the Interior's Standards for the Treatment of Historic Properties and the Guidelines for the Treatment of Cultural Landscapes.* Washington, DC.

1997a *NPS-28: Cultural Resources Management Guideline.* Washington, DC. Available at <http://www.cr.nps.gov/history/online_books/nps28/28contents.htm>.

1997b "Threatened and Endangered Species in Val Verde County." Compiled for use by Amistad National Recreation Area, based on data from the U.S. Fish and Wildlife Service and Texas Parks and Wildlife.

1998a "Personal Watercraft Use within the NPS System, Proposed Rule." *Federal Register,* 63, no. 178 (Sept. 15): 49312–17. Available at <http://www.nps.gov/refdesk/1pwcrule.html>.

1998b "Report on the Findings and Recommendations of the Big Bend Regional Visibility Preliminary Study to the Border XXI U.S.-Mexico National Coordinators." Available at <http://www.aqd.nps.gov/ard/parks/bibe/findings.html>.

1999a *Boat Launch Plan and Environmental Assessment, Amistad National Recreation Area, Texas*. Amistad National Recreation Area, Del Rio, TX.

1999b "Water Quality Concerns Related to Personal Watercraft Usage," by M. VanMouwerik and M. Hagemann. Technical paper. Water Resources Division, Fort Collins, CO.

2000a *Director's Order #9: Law Enforcement Program,* and *Reference Manual #9: Law Enforcement.* Washington, DC. Available at <http://www.nps.gov/policy/DOrders/DOrder9.html>.

2000b *Director's Order #47: Sound Preservation and Noise Management.* Washington, DC. Available at <http://www.nps.gov/policy/DOrders/DOrder47.html>.

2000c *Management Policies 2001.* Washington, DC. Available at <http://www.nps.gov>.

2000d *Strategic Plan for Amistad National Recreation Area, October 1, 2001-September 30, 2005*. Amistad National Recreation Area, Del Rio, TX.

2001a *Amistad National Recreation Area Texas Water Resources Scoping Report.* U.S. Department of the Interior. Technical Report NPS/NRWRD/NRTR-2001/295. September.

2001b *Director's Order #12: Conservation Planning, Environmental Impact Analysis, and Decision-making,* and *Handbook.* Washington, DC. Available at <http://www.nps.gov/policy/DOrders/DOrder12.html> and <http://www.nps.gov/policy/DOrders/RM12.pdf>.

2002a "Decline of Freshwater Mussels of the Rio Grande." Available at <http://www.nps.gov/bibe/rmtracks/winter2002.htm#mussels>.

2002b "Draft PWC Scoping Report, Amistad National Recreation Area." July. Environmental Quality Division, Denver, CO.

2002c "Glen Canyon Draft Environmental Impact Statement PWC Rule-Making." Available at <http://www.nps.gov/glca/pwceis/pwchome.htm>.

2002d "Interior Least Tern Survey of Amistad Reservoir, Val Verde County, Texas." On file at Amistad National Recreation Area, Del Rio, TX.

2002e "Public Use Statistics, Amistad National Recreation Area, 1990–2001." Public Use Statistics Office, Denver, CO. Available at <http://www2.nature.nps.gov/stats>.

2002f "PWC Scoping Report, Amistad National Recreation Area." September. Environmental Quality Division, Washington, DC.

n.d. "Rio Grande Census of the Interior Least Tern." Intermountain Region, Denver, CO.

National Research Council, National Academies of Science
2002 *Oil in the Sea III: Inputs, Fates, and Effects.* Washington, DC: National Academy Press.

National Transportation Safety Board
1998 *Personal Watercraft Safety.* Safety Study NTSB/SS-98/01. Washington, D.C.

Noise Unlimited, Inc.
1996 "Boat Noise Tests Using Static and Full-Throttle Measurement Measures." Prepared for the State of New Jersey, Department of Law and Public Safety.

North American Lake Management Society
2001 "Impacts of Outboard Motors on the Aquatic Environment." Available at <http://www.nalms/bclss/impactsoutboard.htm.> Site visited September 2001.

North Texas Water Garden Society
2002 "Illegal and Invasive Plants." Available at < http://www.ntwgs.org/articles/illegalAquatics.html>. Accessed in 2002.

Notebaert, Peggy
2002 Nature museum. Available at <http://www.chias.org/mic/schools/Liberty/BLACK_TERN_PAGE.html>.

O'Connor, Thomas P.
2000 "Small Boat-derived Chemical Contamination in a National Context." In *Impacts of Motorized Boats on Shallow Water Systems,* Science Workshop Abstracts, November 7–8, 2000, Douglass College Center, Rutgers, the State University of New Jersey. Rutgers, NJ.

Oregon Department of Environmental Quality
1999 "Carbureted 2-stroke Marine Engines: Impacts on the Environment and Voluntary Policy Options to Encourage Their Replacement," by Mindy Correll, Pollution Prevention Team. Final report. Portland, OR. Available at <http://www.deq.state.or.us/programs/P2/reports/marine_engines.html>.

Oris, J. T., A. C. Hatch, J. E. Weinstein, R. H. Findlay, P. J. McGinn, S. A. Diamond, R. Garrett, W. Jackson, G. A. Burton, B. Allen
1998 "Toxicity of Ambient Levels of Motorized Watercraft Emissions to Fish and Zooplankton in Lake Tahoe, California/Nevada, USA." Poster 3E-P005, presented at the 8th Annual Meeting of the European Society of Environmental Toxicology and Chemistry, April 14–18, 1998, University of Bordeaux, Bordeaux, France.

Pearce, D., and D. Moran
1994 *The Economic Value of Biodiversity.* London: Earthscan Publication.

Personal Watercraft Industry Association
2002a "Personal Watercraft and Sound." Available at <http://www.pwia.org/Snd_PWC.htm>. Accessed 2002.

2002b "Sound Level Comparisons." Available at < http://www.pwia.org/sound2.html>. Accessed 2002.

Rodgers, James A., Jr., and Stephen T. Schwikert
2002 "Buffer-Zone Distances to Protect Foraging and Loafing Waterbirds from Disturbance by Personal Watercraft and Outboard-Powered Boats." *Conservation Biology* 16 (February): 216–24.

Rosenberger, Randall, and John Loomis
2000 "Using Meta-Analysis for Benefit Transfer: In-Sample Convergent Validity Tests of an Outdoor Recreation Database." *Water Resources Research* 36(4): 1097–1107.

Sea-Doo
2000 "Personal Watercraft FACTS." Available at <http://www.ozpwc.com/thefacts.html>.

2001a "Bombardier Announces Revolutionary New O.P.A.S. System." Available at <http://www.seadoo.com/usa/seadoo_today/news/010827.html>.

2001b "The New 155 hp, 1494 cc 4-TEC, Four-Stroke." Available at <http://www.seadoo.com>.

Society of Automotive Engineers
2001 "Exterior Sound Level Measurement Procedure for Pleasure Motorboats." J34. Marine Sound Level Subcommittee. Available on the Internet at <www.sae.org>.

Stevenson, J. C., and W. C. Dennison
2000 "The Potential Impacts of Recreational Boating on Submersed Aquatic Vegetation in Upper Chesapeake Bay." In *Impacts of Motorized Boats on Shallow Water Systems,* Science Workshop Abstracts, November 7–8, 2000, Douglass College Center, Rutgers, the State University of New Jersey. Rutgers, NJ.

Suter, G. W., and C. L. Tsao
1996 *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota*. Rev. ES/ER/TM-96/R2. Oak Ridge National Laboratory, TN.

Tahoe Regional Planning Agency
1998 "Lake Tahoe Motorized Watercraft Report — An Integration of Water Quality, Watercraft Use, and Ecotoxicology Issues." Preliminary draft report prepared for the Tahoe Regional Planning Agency.

1999 *Environmental Assessment for the Prohibition of Certain Two-Stroke Powered Watercraft.*

Texas Natural Resource Conservation Commission (Texas Commission on Environmental Quality)
1997 *Second Phase of the Binational Study Regarding the Presence of Toxic Substances in the Rio Grande/Rio Bravo and its Tributaries Along its Boundary Portions Between the United States and Mexico*: Texas Natural Resource Conservation Commission.

2000 "Texas Surface Water Quality Standards." *Texas Administrative Code,* Title 30, Chapter 307. Effective August 17, 2000.

2002a *Draft 2002 Texas Water Quality Monitoring and Assessment Report, Segment 2305, International Amistad Reservoir*. Available at <http://www.tnrcc.state.tx.us/water/quality/02_twqmar/02_305b/2305_fact.pdf>.

2002b *Draft 2002 Water Quality Assessment, Segment 2305, International Amistad Reservoir*. Available at <http://www.tnrcc.state.tx.us/water/quality/02_twqmar/02_305b/2305_data.pdf>.

2002c "Texas Surface Water Quality — What Is It, and How Is It Measured?" Available at <http://www.tnrcc.state.tx.us/water/quality/tmdl/303_expl.pdf>.

2002d *Texas State Implementation Plan.* Available at <http://www.tnrcc.state.tx.us/oprd/sips/siptexas.html>.

Texas Parks and Wildlife Department
1995 *Biological Survey of Lake Amistad Recreation Site Final Report*. Prepared for the U.S. Air Force. Texas Natural Heritage Program Resource Protection Division, Austin, Texas.

2002 Texas Parks and Wildlife Web site. Available at <http://www.tpwd.state.tx.us/>.

Texas, State of
2002 *Texas Parks and Wildlife Code, Title 4: Water Safety, Chapter 31: Water Safety, Section 31.1206. Personal Watercraft.* Available at <http://www.capitol.state.tx.us/statutes/pa/pa0003100.htm1#pa069.31.106>. Site visited Nov. 21, 2002.

Tjarnlund, U., G. Ericson, E. Lindersjoo, I. Petterson, and L. Balk
1995 "Investigation of the Biological Effects of 2-Cycle Outboard Engines' Exhaust on Fish." *Marine Environmental Research* 39: 313–16.

Tjarnlund, U., G. Ericson, E. Lindersjoo, I. Petterson, G. Akerman, and L. Balk
1996 "Further Studies of the Effects of Exhaust from Two-Stroke Outboard Motors on Fish." *Marine Environmental Research* 42: 267–71.

U.S. Census Bureau, U.S. Department of Commerce
2002 Information available at <http://quickfacts.census.gov>. Accessed 2002.

U.S. Department of the Interior
n.d. *Final Environmental Impact Statement, Miccosukee 3-1 Exploratory Well, Broward County, Florida.* Washington, DC.

U.S. Environmental Protection Agency
1974 "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an adequate Margin of Safety." EPA 550/9-74-004. Washington, DC. Cited in Izaak Walton League of America, 1999, *Caught in the Wake. The Environmental and Human Health Impacts of Personal Watercraft,* by Laurie C. Martin.

1993 *Great Lakes Water Quality Initiative Criteria: Documents for the Protection of Aquatic Life in Ambient Water.* Draft. PB93-154656. National Technical Information Service. Springfield, VA.

1994 "The Effects of Marine Engine Exhaust Emissions on Water Quality: Summary of Findings of Various Research Studies." Office of Air and Radiation.

1995 "Final Water Quality Guidance for the Great Lakes System; Final Rule." *Federal Register*, 60 (Mar. 23): 15366–425.

1996a "Air Pollution Control; Gasoline Spark-Ignition Marine Engines; New Nonroad Compression-Ignition and Spark-Ignition Engines, Exemptions; Rule." *Federal Register* 61 (Oct. 4): 52087–106.

1996b "Emission Standards for New Gasoline Marine Engines." EPA 420-F-96-012. EPA Environmental Fact Sheet. Office of Mobile Sources, Ann Arbor, MI.

1996c *Regulatory Impact Analysis: Control of Air Pollution Emission Standards for New Nonroad Spark-Ignition Marine Engines.* ANR-443. Office of Air and Radiation, Office of Mobile Sources, Engine Programs and Compliance Division, Ann Arbor, MI.

1997 "Control of Air Pollution; Amendment to Emission Requirements Applicable to New Gasoline Spark-Ignition Engines." *Federal Register* 62 (April 2): 15805–08.

1998 "National Recommended Water Quality Criteria." *Federal Register* 63 (Dec. 10): 68353–64.

1999a "National Recommended Water Quality Criteria — Correction." EPA822-Z-99-001. Office of Water.

1999b "Power Boating and America's Waters." Available at <http://www.epa.gov/CEIS/atlas/ohiowaters/uses/power_boating_and_america.htm>.

2000a *Latest Findings on National Air Quality: 2000 Status and Trends*. Office of Air Quality Planning and Standards, Research Triangle Park, NC. Available at <http://www.epa.gov/airtrends>,

2000b "Recreational Vehicles, Marine Engines." Region III, Air Protection Division. Available at <http://www.epa.gov/reg3artd/vehicletran/vehicles/recreational_vehicles.htm>.

2001 "National Primary Drinking Water Regulations: Technical Fact Sheet on Benzene." Office of Water. Available at <www.epa.gov/ogwdw000/dwh/t-voc/benzene.htm>.

2002 "El Paso Area Air Pollution Studies." Region 6. Available at <http://www.epa.gov/earth1r6/6pd/air/pd-q/elpaso1.htm>. Accessed 2002.

U.S. Fish and Wildlife Service, U.S. Department of the Interior
1987 "Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review," by R. Eisler. Biological Report 85; Contaminant Hazard Reviews Report 11. Laurel, MD.

2002 "Wood stork." Available at < http://endangered.fws.gov/i/b/sab5z.html>.

U.S. Geological Survey, U.S. Department of the Interior
2001 "Occurrence and Potential Adverse Effects of Semivolatile Organic Compounds in Streambed Sediment, United States, 1992–1995," by T. J. Lopes and E. T. Furlong. Carson City, NV.

University of Texas
2002 "Herps of Texas." Available at <http://www.lifesci.utexas.edu/research/txherps/>. Accessed 2002.

Verschuren, K.
1983 *Handbook of Environmental Data on Organic Chemicals.* 2nd ed. New York: Van Nostrand Reinhold Company.

Vlasich, Brian
1998 "Personal Watercraft: Environmental Effects of a 'Thrill-Craft.'" Claremont Environmental Policy Briefs, Student Edition. Roberts Environmental Center, Claremont McKenna College, Claremont, CA.

Wark, Kenneth, and Cecil F. Warner
1981 *Air Pollution: Its Origin and Control*. 2nd ed. New York: Harper and Row, Publishers.

Western Aquatic Plant Management Society
2002 Hydrilla. Available at <http://wapms.org/plants/hydrilla.html>.

White, J. J., J. N. Carroll
1998 "Emissions from Snowmobile Engines Using Bio-Based Fuels and Lubricants." Final Report. Prepared for Montana Department of Environmental Quality, Helena, MT.

Winger, Parley V.
2000 "Toxicological Assessment of Aquatic Ecosystems." In *Impacts of Motorized Boats on Shallow Water Systems,* Science Workshop Abstracts, November 7–8, 2000, Douglass College Center, Rutgers, the State University of New Jersey. Rutgers, NJ.

Wong, D. C. L., W. R. Arnold, G. A. Rausina, E. R. Mancini, and A. E. Steen
2001 "Development of a Freshwater Aquatic Toxicity Database for Ambient Water Quality Criteria for Methyl Tertiary-Butyl Ether." *Environmental Toxicology and Chemistry* 20 (5): 1125–32.

Yamaha Motor
2001 "World's First 4-Stroke Personal Watercraft." Available at <http://www.yamaha-motor.com/new/07-19_01_wc_press.html>.

Yaws, C. L., Pan Xiang, and Lin Xiaoyin
1993 "Water Solubility Data for 151 Hydrocarbons." *Chemical Engineering,* 100 (n..2): 108–11.

Personal Communications

Amistad Marina, phone conversation with Patricia Steinholtz, URS, re: PWC rentals, 20 August 2002.

DeLaCruz, Augustine. Texas Commission on Environmental Quality. Phone conversation, e-mail, 9 October 2002, re: thermocline.

Finkelstein, Eric. Interpretive Specialist. Amistad National Recreation Area. E-mail correspondence, 7 November 2002.

Fontaine, Monita W, Executive Director, PWIA. Letter to W. Dickinson, NPS, May 28, 2002, re: comment in response to Lake Mead PWC DEIS.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. Park tour, 14 August 2002.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 22 August 2002, re: law enforcement.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 22 August 2002, re: least tern islands.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 22 August 2002, re: plans.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 30 August 2002, re: canoe rentals.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 1 September 2002, re: water and use.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 1 September 2002, re: visitation.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 5 September 2002, re: noise.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 7 September 2002, re: water quality.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 11 September 2002, re: swimmers.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 11 September 2002, re: boats and PWC.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 19 September 2002, re: Amistad numbers.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 20 September 2002, re: enforcement.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 2 October 2002, re: PWC visitation.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 2 October 2002, re: PWC other boaters.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 3 October 2002, re: shoreline landing.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 5 November 2002, re: wildlife.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 5 November 2002, re: shoreline camping.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 5 November 2002, re: enforcement.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 6 November 2002, re: water levels.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 6 November 2002, re: enforcement.

Garetz, Greg. Park Law Enforcement Ranger. Amistad National Recreation Area. E-mail correspondence, 6 November 2002, re: wetlands.

Labadie, Joseph. Cultural Resources Program Manager. Amistad NRA. Scoping meeting, 15 August, 2002.

Labadie, Joseph. Cultural Resources Program Manager. Amistad NRA. E-mail correspondence, 20 August, 2002.

Labadie, Joseph. Cultural Resources Program Manager. Amistad NRA. E-mail correspondence, 1 October, 2002, re: cultural resources access.

Labadie, Joseph. Cultural Resources Program Manager. Amistad NRA. E-mail correspondence, 1 October, 2002, re: accessible rock art.

Labadie, Joseph. Cultural Resources Program Manager. Amistad NRA. E-mail correspondence, 1 November, 2002, re: wave action.

Larson, David. Biological Resource Specialist. Amistad National Recreation Area. Park tour, 14 August 2002.

Larson, David. Biological Resource Specialist. Amistad National Recreation Area. Scoping meeting, 15 August 2002.

Larson, David. Biological Resource Specialist. Amistad National Recreation Area. E-mail correspondence, 9 September 2002, re: beaver, backcountry use.

Larson, David. Biological Resource Specialist. Amistad National Recreation Area. E-mail correspondence, 2 October 2002, re: shoreline vegetation.

Larson, David. Biological Resource Specialist. Amistad National Recreation Area. Phone conversation, 3 October 2002, re: threatened and endangered species.

Larson, David. Biological Resource Specialist. Amistad National Recreation Area. Phone conversation, 31 October 2002, re: park zoning, migratory birds.

Larson, David. Biological Resource Specialist. Amistad National Recreation Area. Phone conversation, 4 November 2002, re: T&E species.

Larson, David. Biological Resource Specialist. Amistad National Recreation Area. Phone conversation, 8 November 2002, re: T&E species.

Larson, David. Biological Resource Specialist. Amistad National Recreation Area. Phone conversation, 8 November 2002, re: wetlands.

Morgan, M. Mark, Management Assistant, Amistad National Recreation Area. E-mail correspondence, 18 September 2002, re: marina.

Rosenlieb, Gary. NPS Water Resources Division (WRD). 2001, re: antidegradation. From Big Thicket PWC EA.

Salazar, Amelia. Texas Parks and Wildlife Department. Phone and E-mail communications, 9 September and 17 September 2002, re: pleasure boat and PWC registration for the state of Texas from 1997 to 2001.

Schmidt, M. U.S. Coast Guard. E-mail correspondence with Louis Berger Group, Inc., re: Gateway National Recreation Area, 4 September 2001.

LIST OF PREPARERS

National Park Service

Amistad National Recreation Area

Alan Cox, Superintendent. Coordinated park activity relative to the environmental assessment. Experience: 28 years with the National Park Service at eight different units.

Dennis Anderson, Park Ranger, Law Enforcement. Knowledgeable of park resources and boating operations. Assisted with alternatives development during the scoping phase. Experience: 16 years as a law enforcement ranger at Amistad; park boat operations trainer and park boat safety officer.

Eric Finkelstein, Interpretive Specialist. Contributed to visitor expectation and experience issues. Experience: 20 years with National Park Service/US Forest Service.

Gregory S. Garetz, Park Ranger, Law Enforcement. Wrote the proposed rulemaking document for PWC use at Amistad National Recreation Area; coordinated the collection of data on PWC use at Amistad. Experience: 24 years with the National Park Service, 19 at Amistad National Recreation Area.

Joseph H. Labadie, Cultural Resource Program Manager. M.A., North American Archeology. Assisted with cultural resource issues. Experience: 16 years at Amistad National Recreation Area.

David H. Larson, Natural Resources Program Manager. Experience: Eight years with the National Park Service. Assisted with natural resource issues.

Air Resources Division, Washington Office

Tamara Blett, Ecologist. M.S., Forest Ecology. Assisted in developing air quality methodology. Experience: 15 years air resource management experience with the National Park Service and USDA Forest Service.

John D. Ray, Program Manager for the Gaseous Pollutant Monitoring Program. Ph.D., Chemistry. Assisted in developing air quality methodology. Atmospheric chemist. Experience: 9 years with National Park Service.

Aaron Worstell, Environmental Engineer. B.S., Chemical Engineering. Assisted in developing air quality methodology. Experience: 9 years experience in air quality (5 federal, 4 state).

Environmental Quality Division, Washington Office

Sarah Bransom, Compliance Program Coordinator. MRP (Master's Degree, Environmental Planning). Managed all PWC environmental assessments for the National Park Service. Experience: 24 years NEPA compliance (federal service).

Intermountain Region Support Office

Rick Ernenwein, Overflights and Noise Program Coordinator. B. S., Renewable Natural Resources. Assisted in developing soundscape methodology. Experience: 15 years with NPS noise and NEPA issues; 23 years federal service.

Water Resource Division, Washington Office

Gary Rosenlieb, Hydrologist, Water Quality Program Coordinator. M. S., Water Resources Management. Assisted in developing water quality methodology. Experience: 23 years federal service, with primary experience in water quality management and environmental impact analysis for water resources issues.

Mark VanMouwerik, Contaminants Specialist / CSU Research Associate. M.S., Environmental Health. Worked with fate and effects on contaminants in the environment. Experience: 5 years with National Park Service.

Consultants

URS Corporation

Thomas G. Campbell, Consultant and Leader, Risk Assessment Team. M.S., Marine Biology. Refined approach to evaluating surface water quality impacts. Experience: Over 25 years experience in aquatic and marine ecology, water quality, toxicology, and ecological risk assessment.

K.C. Collins, AICP, Transportation Planner, Masters in Urban & Regional Planning; B.A. Mathematics, responsible for calculating projections and noise impact analysis. Experience: 3.5 years experience with various NEPA documents and processes.

John Crawford, P. E., Senior Transportation Engineer. B.S., Civil Engineering. Responsible for air and noise analysis. Experience: 10 years plus in air and noise evaluation.

James Denier, Senior Consultant and Leader, Environmental Assessment Team. B.A., Biology; M.B.A., Business Management. Responsible for overall project coordination. Experience: Over 22 years in environmental planning, assessment, and compliance.

James Doenges, Senior Scientist, M.S., Biology and B.S., Biology. Responsible for ecological analysis. Experience: Over twenty years experience in environmental impact assessment and natural resource management.

Jessica T. Lau, Senior Environmental Scientist. B.A., Botany; B.S. Geology; M.A., Natural Science. Responsible for air quality analysis and technical review. Experience: Over 14 years in air quality, including various NEPA projects.

Robert Mutaw, Cultural Resources Specialist, Ph.D., Anthropology. Responsible for cultural resources analysis and technical review. Experience: Over 23 years in cultural resources analysis, including various NEPA projects.

Greg Sorensen, Technical Writer/Editor. B.A., International Affairs. Responsible for editing document. Experience: 27 years.

Patti Steinholtz, NEPA Planner, Editor/Graphic Illustrator. B.A., Communications and English. Responsible for research, coordination, and preparation of document; also responsible for editing text and preparing maps. Experience: 2 years with NEPA documentation; 10 years as graphic artist; 6 years as writer.

Nancy VanDyke, Senior Consultant and Leader, Regulatory Team. B.A., Biology and Geography; M.S., Environmental Sciences. Responsible for technical review of document, water quality methodology. Experience: Over 22 years in environmental planning, assessment, and compliance.

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historic places, and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

NPS D-56 (March 2003)